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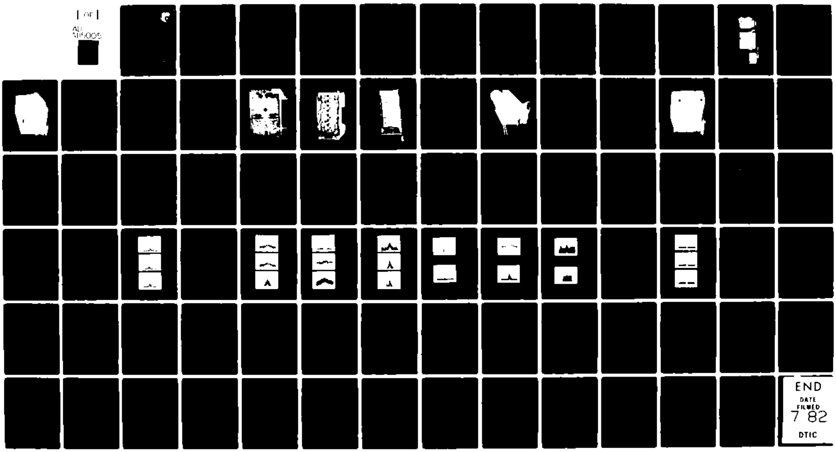

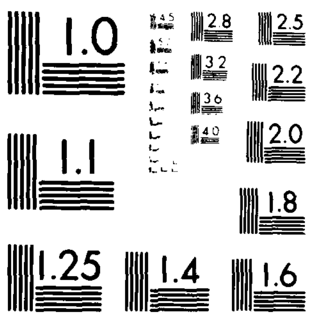

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AFWAL-TR-81-1152

ONE KILOWATT UHF SOLID STATE POWER AMPLIFIER

AD A115005

Wayne Fischbach

System Avionics Division
Information Transmission Branch

February 1982

Final Report for Period September 1978 - February 1981

Approved for public release; distribution unlimited.

AVIONICS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
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Wayne O. Fischbach

WAYNE O. FISCHBACH
Project Engineer, AFWAL/AAAI

CHARLES C. GAUDER
Chief, Information Transmission Branch
Avionics Laboratory

FOR THE COMMANDER

Richard H. Boivin

RICHARD H. BOIVIN, Colonel, USAF
Chief, System Avionics Division
Avionics Laboratory

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Satellite Communications
Hopping Filter

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The One-Killowatt UHF Solid State Amplifier System (AN/ASC-31) is a state of the art airborne amplifier containing a fast tuning filter. This system interfaced with an AN/ARC-171 and modem generates a 1KW "clean" signal capable of fast hopping across the 225-400 MHz UHF frequency band. This report contains a description of the system and test results. The various tests accomplished with the system and described in this report are power input versus power output, intermodulation products measurement, thermal, and satellite tests.

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FOREWORD

This technical report was prepared by Personnel of the Information Transmission Branch (AAAD), of the AF Wright Aeronautical Laboratory, Avionics Laboratory, Wright-Patterson Air Force Base, Ohio. This work was accomplished under Project No. 1227 Task 0328.

This effort was accomplished during the period of September 1978 through February 1981.

The project engineer for this effort was Lowell Nauman; Wayne O. Fischbach designed the tests, directed the test effort, analyzed the data, and prepared this report.

Following is a list of individuals involved in this test program:

Personnel	Agency
A. Johnson	AFWAL/AAAD
T. A. Grizinski	AFWAL/AAAD
R. Swanson	AFWAL/AAAD
L. Nauman	AFWAL/AAAD
1st Lt. R. N. Wright	
2nd Lt. R. Duffer	
TSGT J. Cary	
TSGT O. Sammons	
W. Hunt	AFWAL/AAAD
J. J. Foshee	AFWAL/AAAD
2nd Lt. K. Mabry	AFWAL/AAAD
W. Rembaez	Rockwell/Collins

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SECTION I

INTRODUCTION

In order to increase the anti-jam capability of the UHF satellite communication (SATCOM) systems, a fast-tuning 1 kilowatt (kw) UHF airborne power amplifier is required. Present airborne UHF SATCOM systems utilize 100 watt transceivers for their anti-jam SATCOM links. Several kw power amplifiers are in production; however, since they do not provide the tuning time required for a frequency hopping anti-jam UHF satellite system, development of an all solid state 1 kw power amplifier was undertaken. The Avionics Laboratory awarded the development contract to Motorola Inc. A major design goal of the development was the filtering of the output of the 1 kw amplifier so that it passed only the desired signal and excluded the broadband noise and spurious undesired signals. While the previous generation of UHF transceivers utilized tune circuits in their transmit and thereby minimized the broadband noise and spurious outputs, the present generation of solid state UHF transceivers generates high levels of broadband noise and spurious signals. If these noise levels are amplified by the 1 kw power amplifier, they cause considerable interference to other UHF systems on-board the using aircraft. For this reason, the 1 kw UHF power amplifier was designed with an integral tuning filter to clean up the input from the UHF transceiver and minimize the transmitted noise and spurious output. Thus the 1 kw UHF power amplifier (AN/ASC-31) not only increases the output level of the UHF driver, but actually reduces the broadband noise and spurious output, helping to solve RFI/EMI problems which are present in installations using UHF transceivers of modern design.

SECTION II

DESIGN AND DESCRIPTION OF EQUIPMENT

1. AMPLIFIER SYSTEM DESIGN

The 1 kw UHF power amplifier (AN/ASC-31) was designed to provide 13-20 db of power gain from an input UHF transceiver which operates anywhere in the 225-400 MHz frequency range. It will output 1000 watts of clean UHF power with harmonics down at least 60 db and spurious down 80 db. The system requires 4000 watts of primary 400Hz power. The AN/ASC-31 system is comprised of three units: a power amplifier, a power supply, and a remote control head. (Figure 1) These units are physically housed as follows:

a. Power Amplifier

- 1 ATR Type Case (10.12" x 8.5" x 19.56")
- Weight: 60 lbs.

b. Power Supply

- ½ ATR Case (5" x 7.62" x 19.56")
- Weight: 30 lbs.

c. Remote Control Head

- Cockpit Control Box Configuration (5 3/4" x 4 1/8" x 4")
- Weight: 2 lbs.

The system has a calculated mean time between failure of approximately 4000 hours. A system interconnection diagram is shown in Figure 2.

2. POWER AMPLIFIER DESCRIPTION

The power amplifier unit consists basically of the following modular shielded sub-assemblies:

- Three identical 400 watt Modules
- Collocation Filter
- Bite
- VCA
- Low Pass Filter
- Power Sensor

See Table 1 for a list of the systems RF control functions.

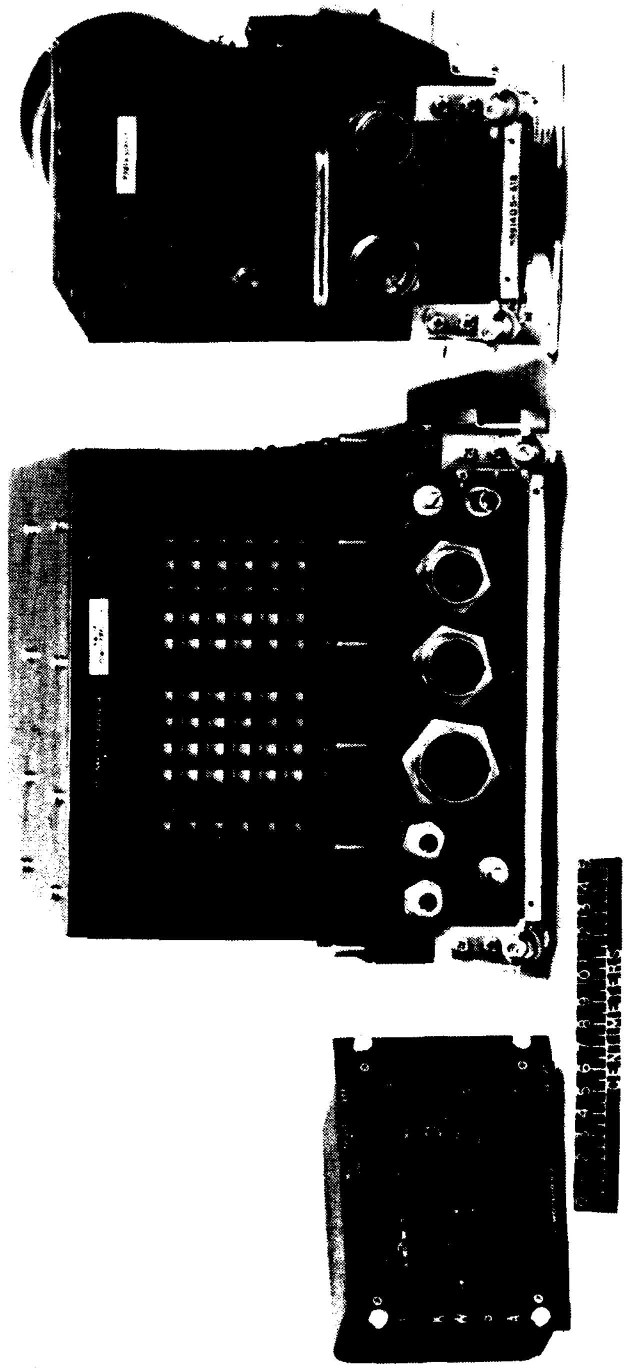


Figure 1. 1 Kw Power Amplifier System (AN/ASC-31)

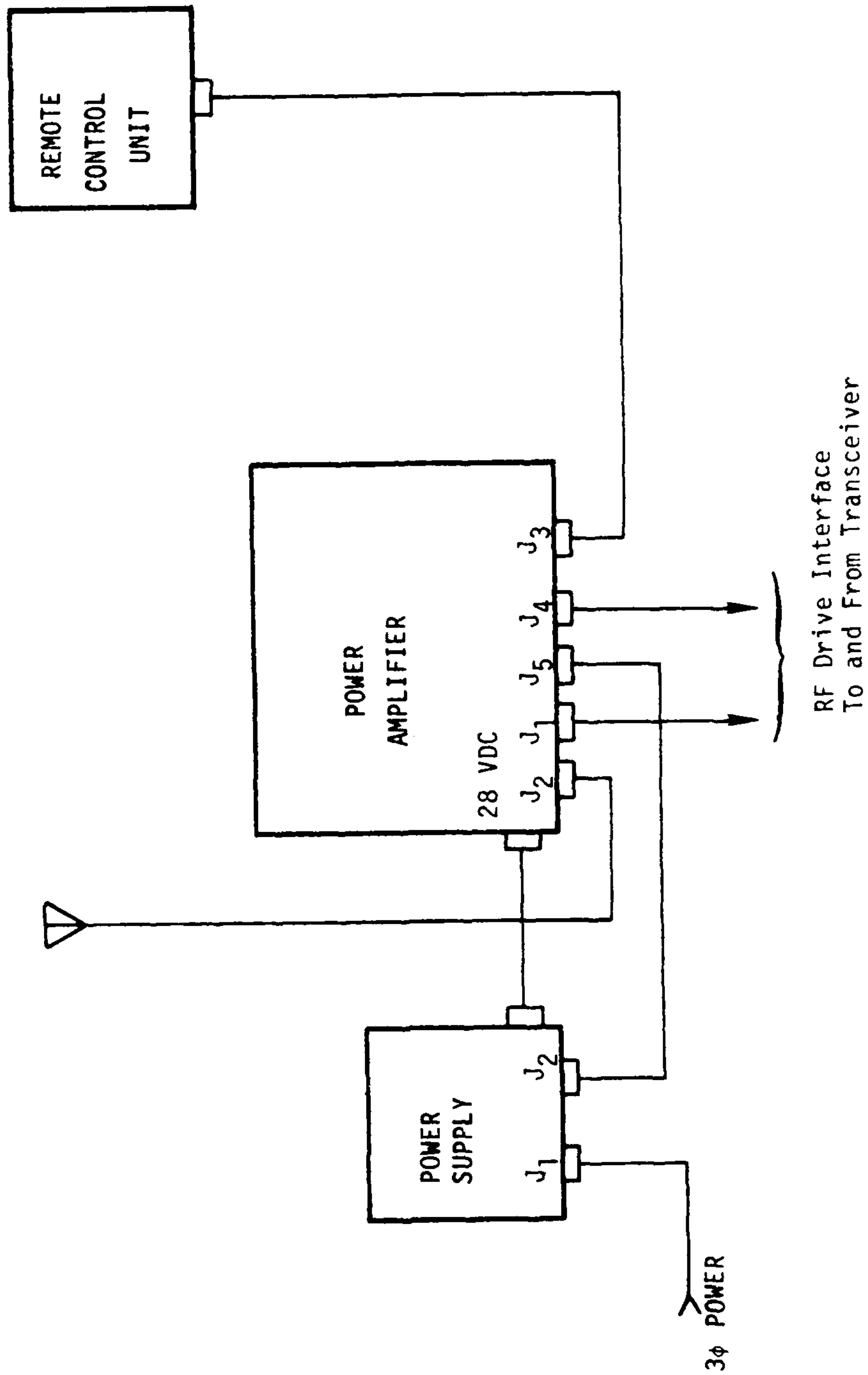


Figure 2. AN/ASC-31 1 Kw P.A. System Interconnection

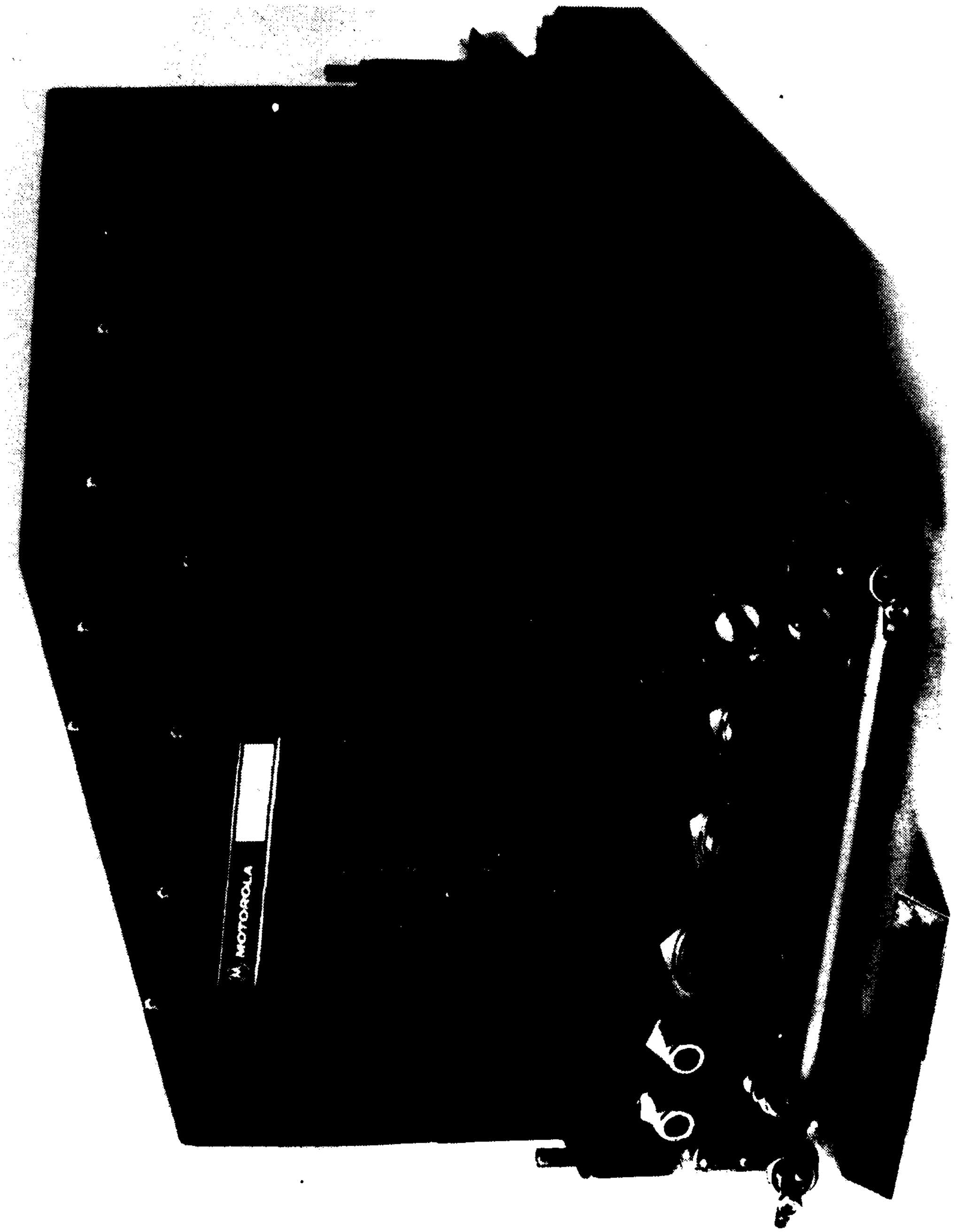


Figure 3. 1 Kw Amplifier Unit

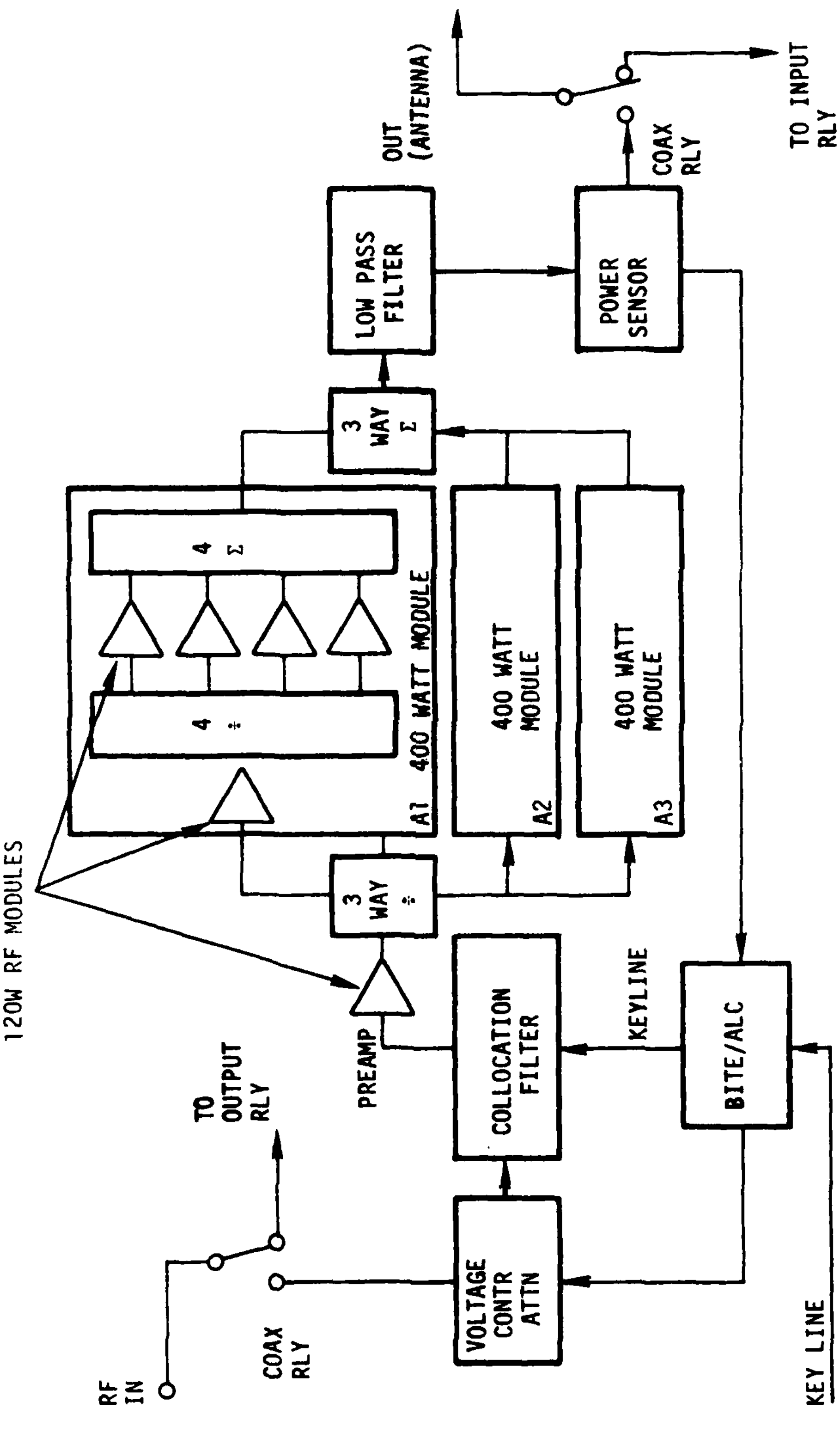


Figure 4. One Kilowatt UHF Power Amplifier Unit Block Diagram

TABLE 1

SYSTEM RF CONTROL FUNCTIONS

1. Output Power Level Control

   A. FM, Full Power or Half Power Modes

2. Protection Circuits

   A. VSWR
   B. Peak Power
   C. Thermal
   D. 28 VDC Power Supply High and Low Voltage
   E. Input RF Power High and Low
   F. Module Fault Detection (Amplifiers, Power Sensor, VCA)
   G. Power Supply Fault
   H. Driver Amplifier Disable during Relay Switching

3. BITE

   A. Fault Detection of Low Output Power
   B. Latching Circuits Provided for Fault Identification After a Bypass Fault
   C. Driver & Carrier Indicator Driver Circuits

At the input to the power amplifier, the RF signal enters a coaxial bypass relay which, if not energized, will bypass the amplifier and pass the drive signal directly to the antenna. This will happen in receive, or if the internal amplifier fault detection circuitry senses a problem. Once the relay is energized, the input signal is then controlled by a voltage-controlled attenuator to an output level of approximately 20 watts maximum. The signal is then processed through a collocation filter which reduces the broadband noise and spurious signals by approximately 60 db while maintaining unity gain. This is an active rather than a passive filter, and through a digital tuning interface circuitry is capable of tuning to any frequency in the 225-400 MHz band in 300 microseconds. From the filter the "clean" signal enters the amplification stages of the power amplifier unit.

The amplifier is constructed of a series of RF power modules. These power modules are built up from two 100 watt transistors, matched and derated for reliability to provide a power output of 120 watts (Figure 5). Four of these units are combined to provide a 400 watt power module (Figure 6). Three of these 400 watt power modules are combined through specially designed hybrids to provide the 1 kw power output. The RF signal is then fed through a low pass filter and is detected by a power sensor which drives the BITE/ALC (Automatic Level Control) circuitry (Figures 7,8) thus maintaining the desired 1 kw power output regardless of input gain variations.

3. POWER SUPPLY DESCRIPTION

A photograph and block diagram of the power supply unit is shown in Figures 9 and 10.

Primary power to the system is 115 VAC, 30, 400 hertz. The power supply unit uses this primary in an AC-to-DC converter to supply +28 VDC @ 150 amps.

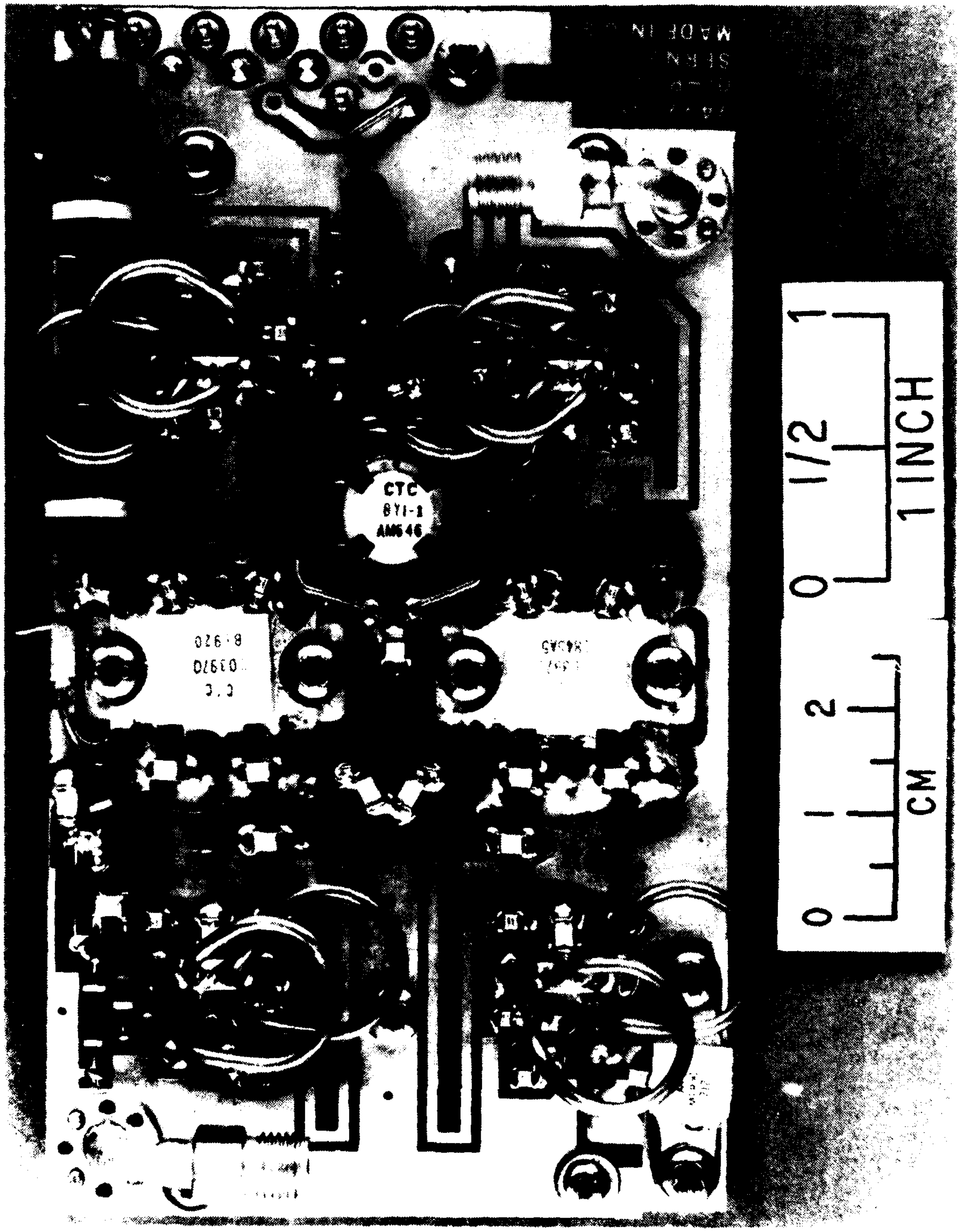


Figure 5. 120 Watt Module

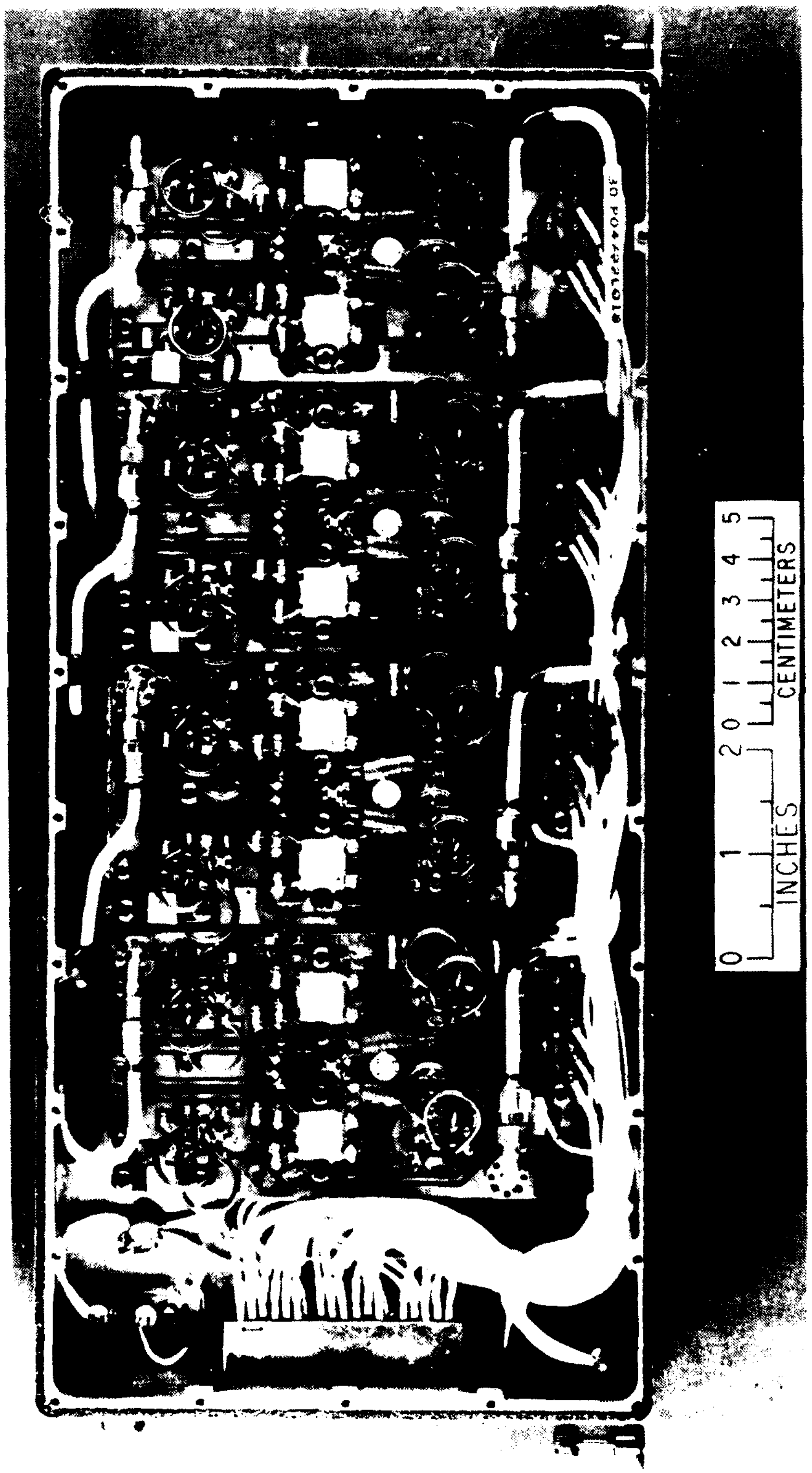


Figure 6. 400 Watt Module

Figure 7. 1 Kw P.A. RF Control (Bite and ALC)

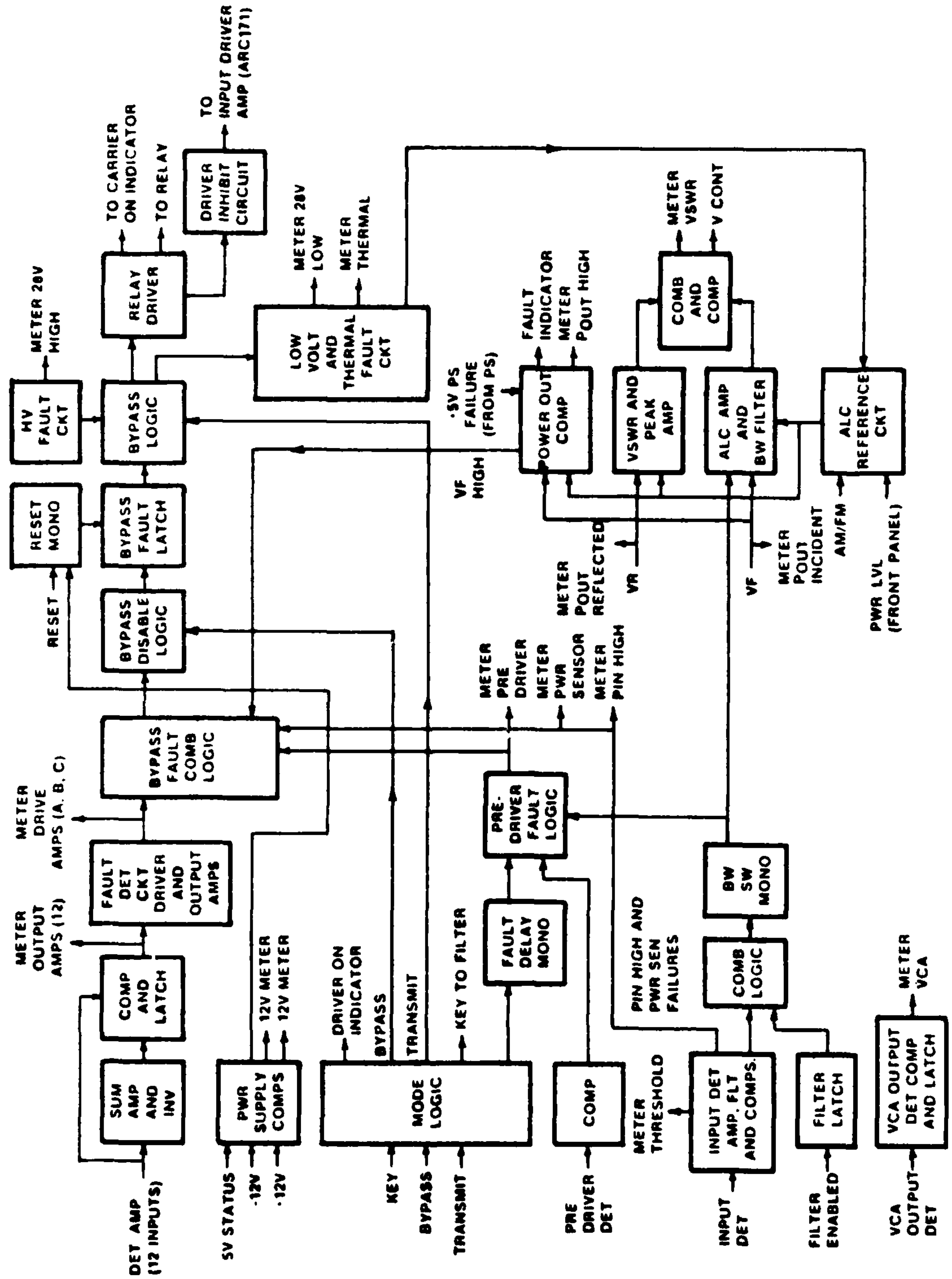


Figure 8. Block Diagram, ALC and Protection

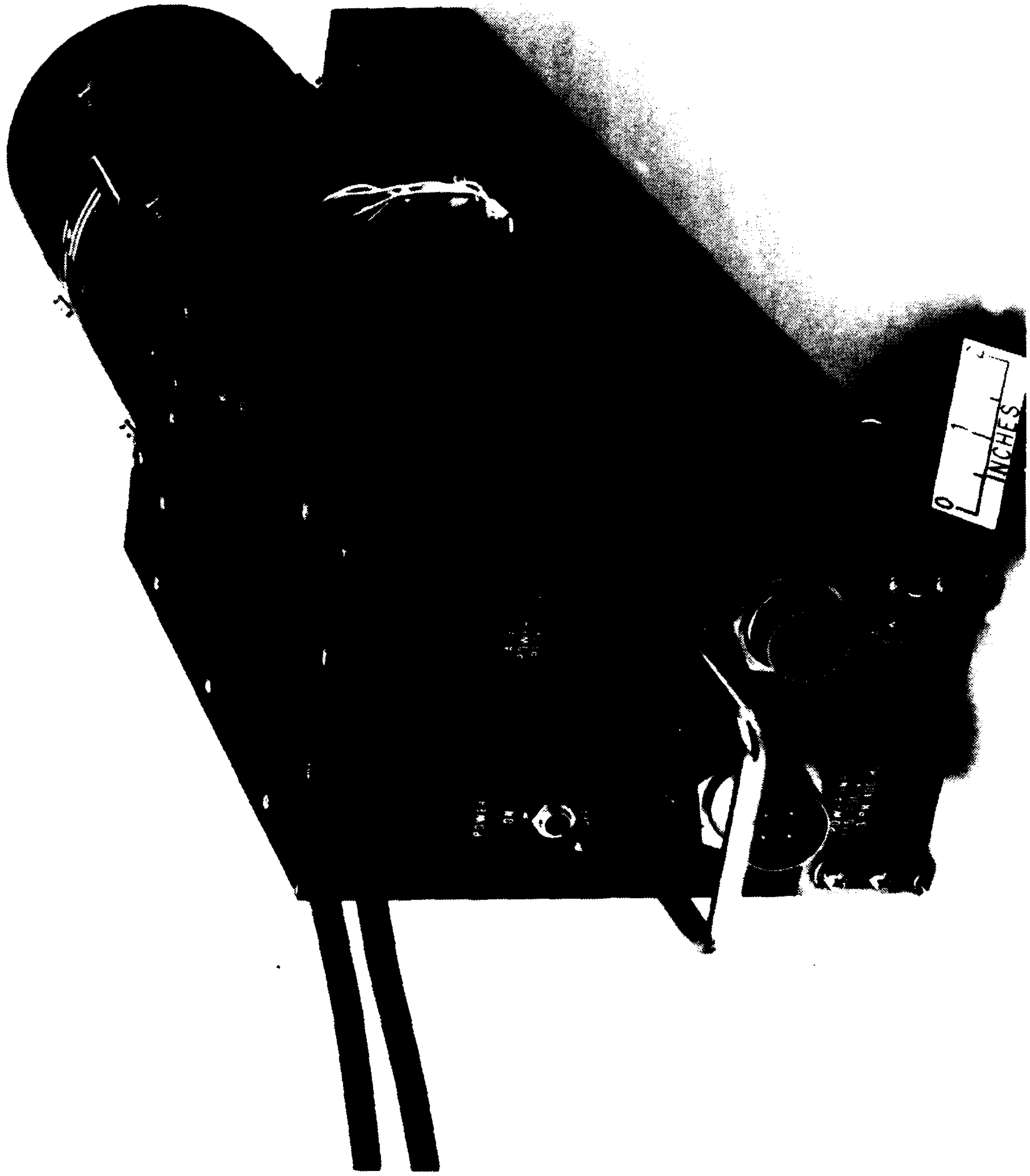


Figure 9. 1 Kw P.A. Power Supply Unit

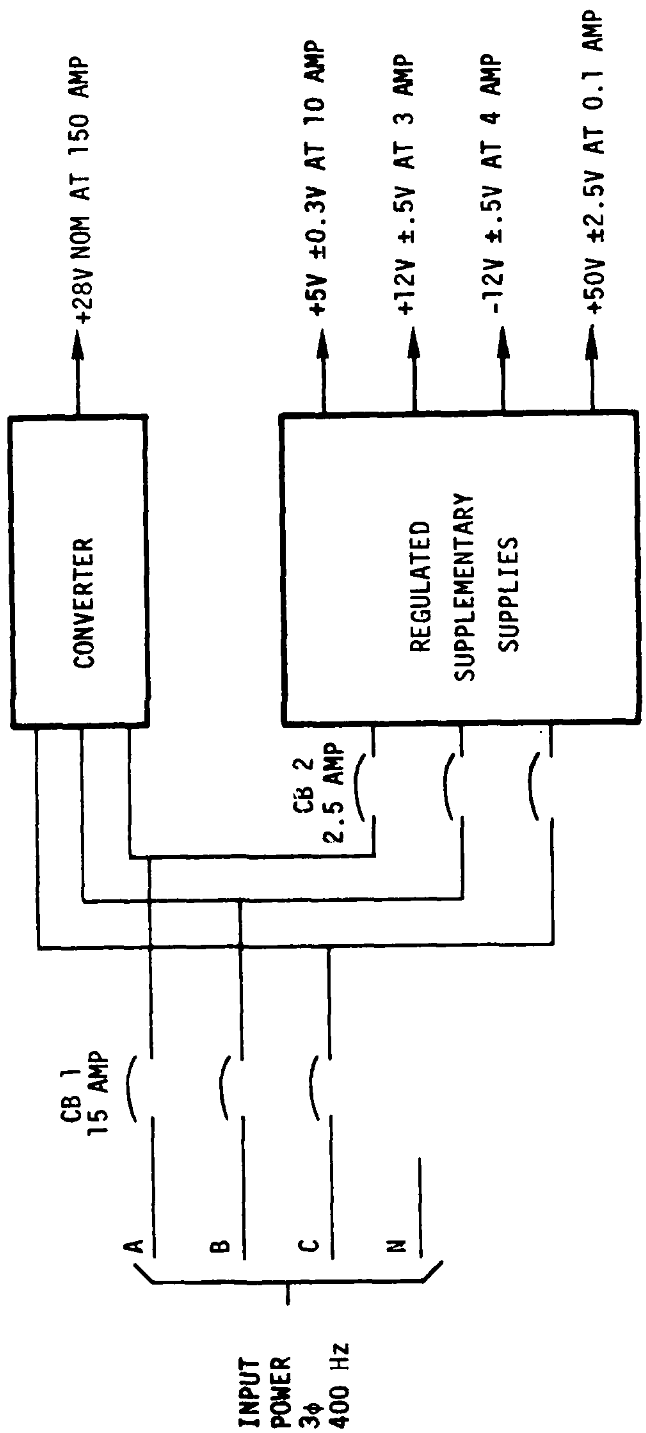


Figure 10. Block Diagram of Power Supply Unit

The primary power is also transformed to lower voltages, rectified and used to develop the following voltages:

- +5 VDC @ 10 amp.
- +12 VDC @ 3 amp.
- -12 VDC @ 4 amp.
- +50 VDC @ 1 amp.

Each of these voltages is regulated and along with the 28 VDC is fed to the power amplifier unit.

4. REMOTE CONTROL UNIT DESCRIPTION

The remote control unit (Figure 11) contains indicator lamps allowing the operator to determine the following:

- PWR Lamp - illuminated if system power on
- Driver Lamp - illuminated if system keyed
- Carrier Lamp - illuminated if system RF power output
- Bypass Lamp - illuminated if system in bypass mode because of problem.

The remote control unit also contains the BITE selector switches and indicator, a full power (1 kw) or half power (500 watt) selector switch, and a mode selector which can select one of three modes:

- Transmit
- Transmit/Receive
- Bypass.

From the control panel the operator can also reset fault sensing circuitry after a transmission in which a fault has occurred. This, in conjunction with the BITE indicator, is a trouble-shooting tool. Table 2 specifies the remote panel meter indications.

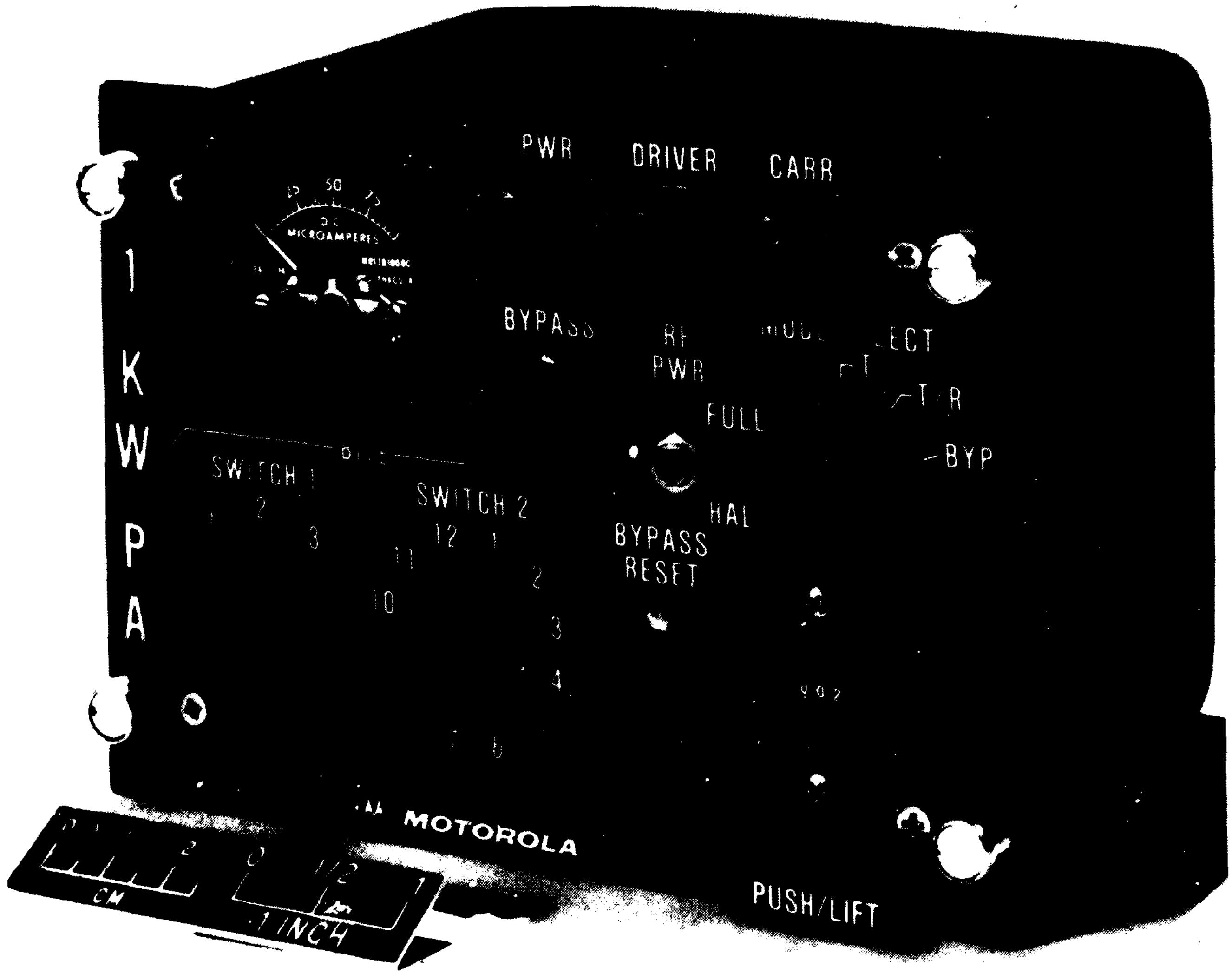


Figure 11. 1 Kw P.A. Remote Control Unit

TABLE 2

REMOTE PANEL METER POSITIONS

SW2 POS	SW1 POS1	SW1 POS2	SW1 POS3
1	P_{OUT} Incident (1000W Full Scale)	P_{OUT} High	Output Ampl 1A
2	P_{OUT} Reflected (200W Full Scale)	P_{IN} High	Output Ampl 2A
3	+50V (Analog)	P_{IN} Low	Output Ampl 3A
4	+28V (Analog)	Filter Module 1	Output Ampl 4A
5	+12V (Analog)	Filter Module 2	Output Ampl 1B
6	+5V	Filter Module 3	Output Ampl 2B
7	-12V	VCA	Output Ampl 3B
8	Thermal (Analog)	Predriver Ampl	Output Ampl 4B
9	28V Low (Analog)	Driver Ampl A	Output Ampl 1C
10	28V High	Driver Ampl B	Output Ampl 2C
11	Power Sensor	Driver Ampl C	Output Ampl 3C
12	VSWR	N/A	Output Ampl 4C
Go/No Go unless otherwise specified			

SECTION III

DESCRIPTION OF TESTS

1. LABORATORY AND FLIGHT PRELIMINARY TESTS

The tests described herein were accomplished on board the 4950th Test Wing Aircraft C135B/2662 and within the AFWAL/AAAD ground station (Rooftop Facility).

After the interface was wired with the AN/ARC-171 transceiver within the Dual Modem System, an initial checkout was made of the combined system in all possible combinations of modes of the Dual Modem and 1 kw systems. A problem of a fault indication which had to be manually reset after each transmission in all the modes (AFSAT, Alternate and LES) of the dual modem was noted. Research into this problem noted that the key-off signal input to the 1 kw was tied to the key-off command line between the dual modem and AN/ARC-171 which is the only possible place to sense this signal. Further testing concluded that the RF dropped off immediately at the end of a transmission, but the key-off line took approximately 60 m/sec to reach the appropriate voltage level. Within the dual modem, a 1 μf capacitor was designed in the key-off circuitry for EMP purposes and causes the slow rise time of the key-off voltage which does not affect the AN/ARC-171. See Figure 12 for description of this problem. The 1 kw system is designed with a maximum acceptable time differential of 6 m/sec between loss of RF and key-off signal. Thus, the cause of the fault indication after each transmission was caused by the immediate loss of RF and 60 m/sec delay of the key-off signal. In a discussion with Linkabit Corporation (the manufacturer of the dual modem system), it was determined that the 1 micro farad capacitor could be removed from the circuit without impeding the operation of the system. This was accomplished, eliminating this fault indication and allowing further testing of the system. Further into the testing program the AN/ASC-31 systems were returned to Motorola and a threshold modification was implemented within the BITE control circuitry eliminating this

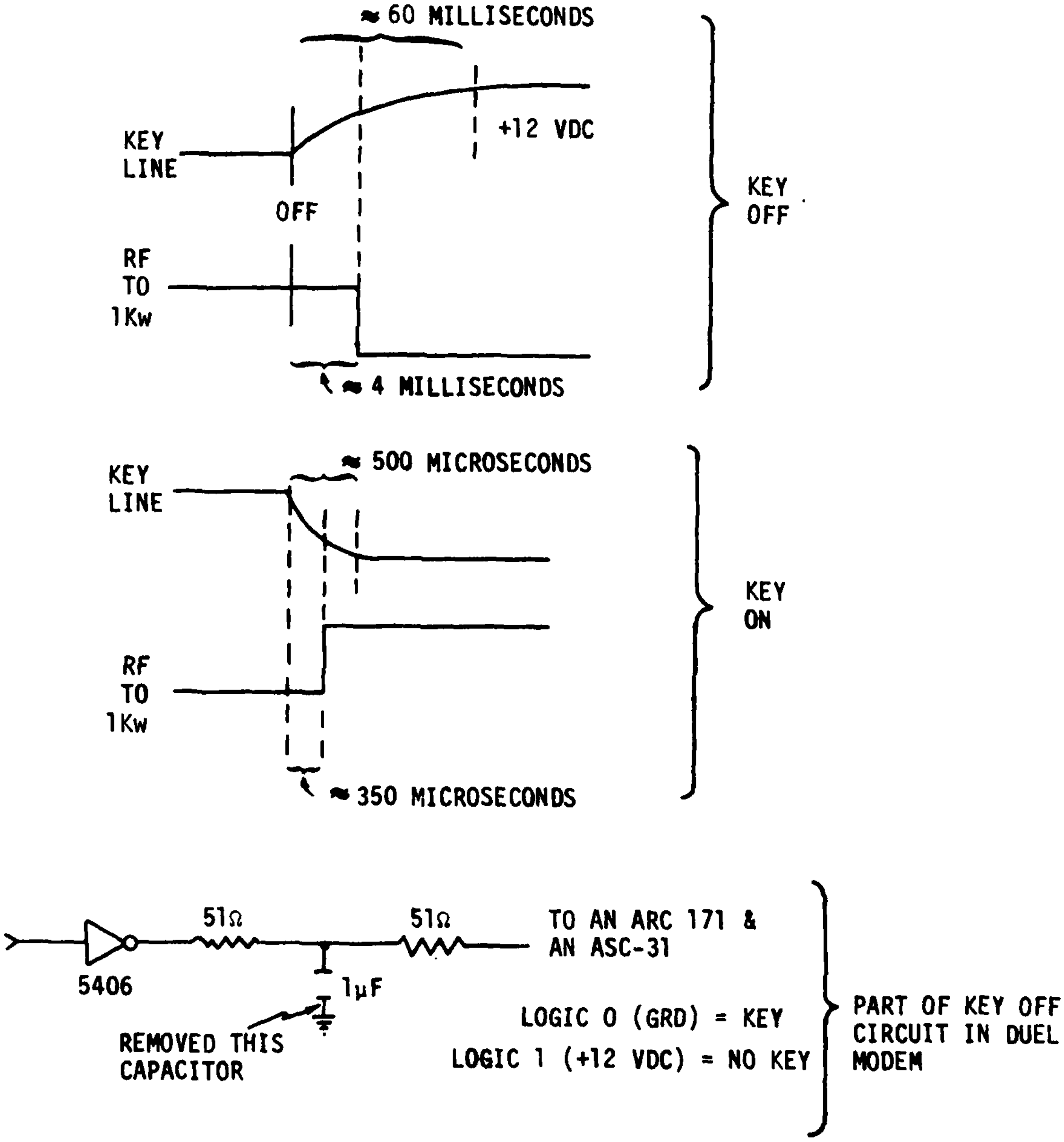


Figure 12. Key Off vs RF Drive to AN/ASC-31 1 Kw Amplifier

problem while retaining the total system integrity. The one microfared capacitor was reinstalled in the dual modem system.

The system was then tested in the LES mode (5 hops/sec) with various fault indications during approximately 80% of the transmissions. The dual modem was then stepped across the 225-400 MHz band in the AFSAT Alternate mode in 10 MHz steps to try to determine if the problem was frequency related. (Table 3).

This test was accomplished while transmitting into a dummy load. The RF output of the 1 kw was then recorded on a high speed visicoder to look for spurious signals in the AN/ARC-171 RF output or any other cause of the various fault indications. Examples of the results are shown in Figures 13 through 17.

During this test, it was noted that the system requires 20 msec switching time from the time a fault sensing circuit turns off the 1 kw until RF is passed in the bypass mode (Figure 13).

It was determined that the "Power in HI" fault sensing threshold was set too low. The value of R159 in the RF control circuit was changed to increase this threshold. The system was checked again across the band and all worked well except at 375 MHz a "VCA" and "RF" amplifier (4A) fault occurred. While working on the two 1 kw systems previously, the 400 watt module "A" had been interchanged between systems (S/N001 and S/N002). This was swapped back, and the systems worked in AFSAT Alternate, and LES (300 msec hop) modes. There is a fault sensing threshold for each of the 120 watt amplifiers and each of these thresholds needs to be matched, or the overall 1 kw fault sensing threshold will cause the system to switch into the bypass mode. The problem was that the 120 watt module "4A" was not within the window of the overall sensing circuit.

TABLE 3

PRELIMINARY TESTING ACROSS BAND AND INDICATED FAULTS

FREQUENCY (MHz)	Fault Indication
225	no fault
230	no fault
240	no fault
250	no fault
260	no fault
270	no fault
280	no fault
290	no fault
300	no fault
310	VCA fault
320	fault lite, no BITE indication
330	fault lite, no BITE indication
340	fault lite, no BITE indication
350	fault lite, no BITE indication
360	Power In Hi fault
370	VSWR fault
380	no fault
390	no fault
399.975	no fault
371	VCA and RD AMP (4a) fault
381	Power In Hi fault

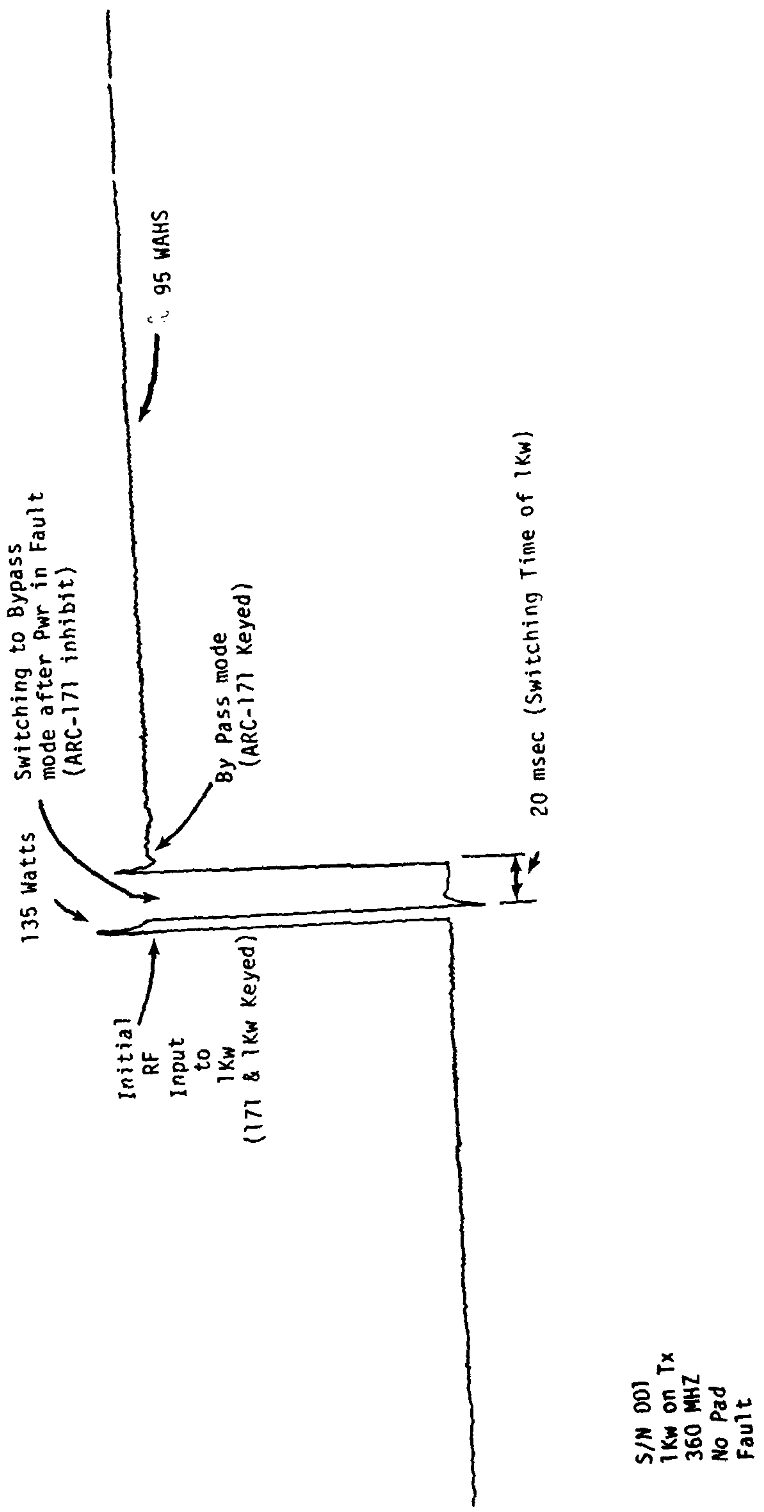


Figure 13. Delay Between Fault Detected vs Bypass Switch Time

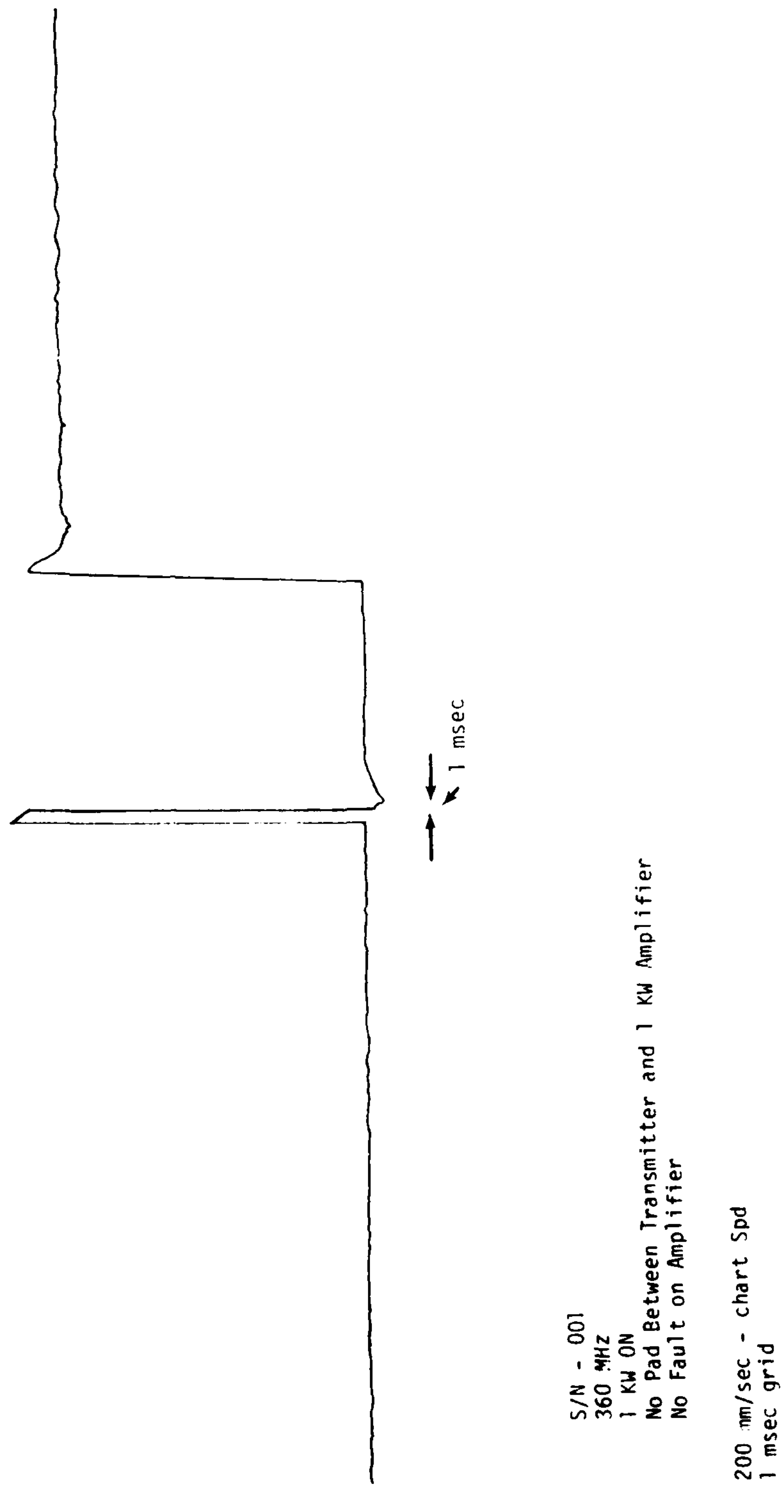
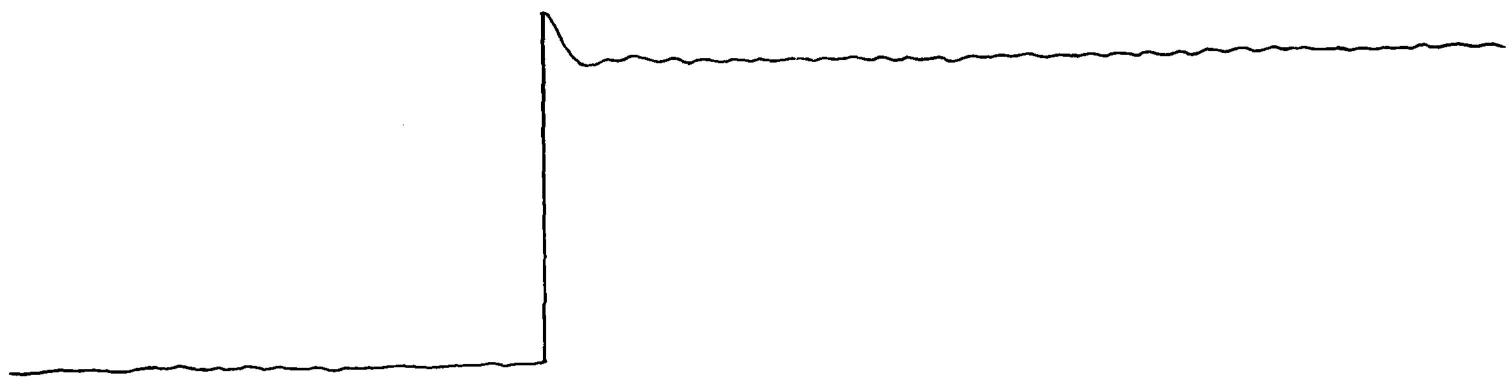


Figure 14. AN/ASC-31 RF Output Fault Detected and Bypass Switched



S/N - 001
360 MHz
1 Kw ON
4db Pad Between Transmitter and 1 KW Amplifier

1 msec grid

Figure 15. AN/ASC-31 RF Output (4db Pad Between AN/ARC-171 and 1 Kw)
(No Fault)

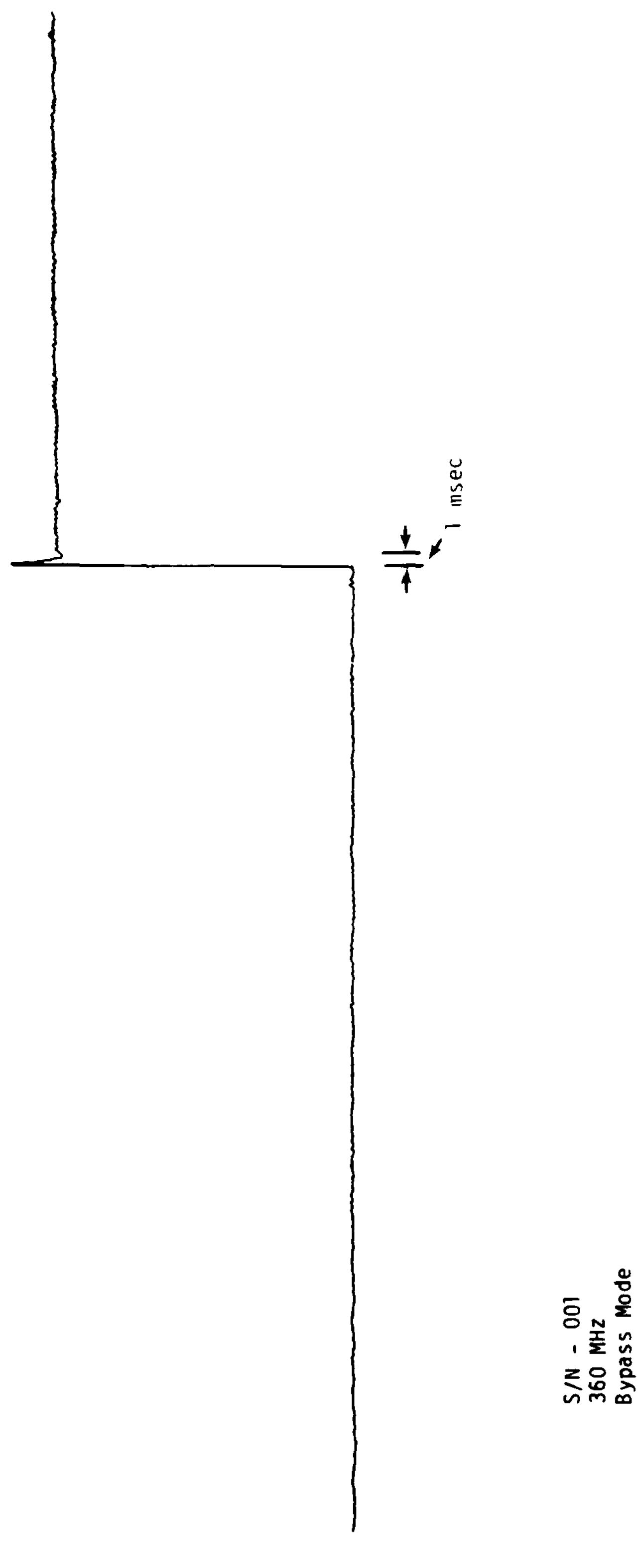


Figure 16. AN/ASC-31 Output with System in Bypass Mode

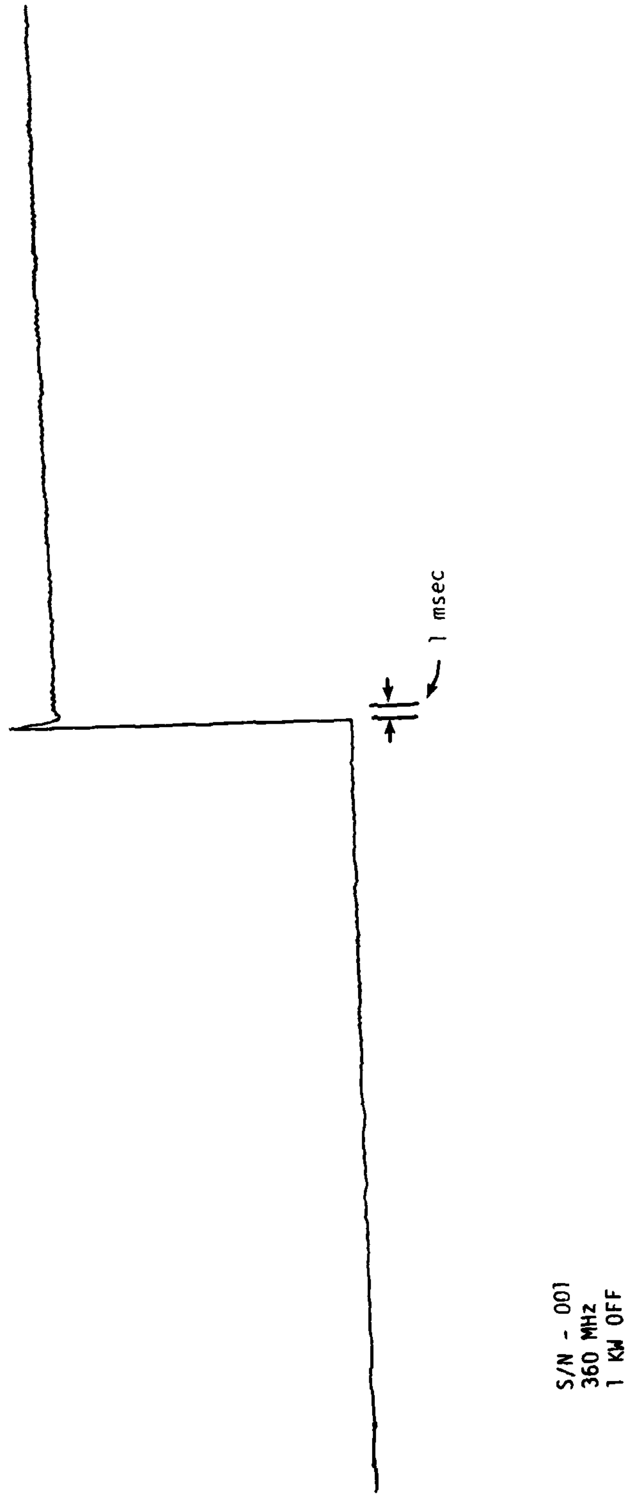


Figure 17. RF Output of AN/ASC-31 With System Switched Off

This could create a problem in interchanging modules for troubleshooting or repair of a 1 kw system.*

Periodically a "preamp fault" would occur in the hopping mode. It was determined that all the system fault thresholds were set in a static mode and the duty cycle (5 msec on - 300 μsec off) changes in the hopping mode. To accommodate this, the threshold of the preamp fault circuitry was changed.

The only remaining problem with the system in the initial checkout was that in the LES (5 msec hop) mode the fault indicator is dimly lit during transmissions. This did not cause the system to go into the bypass mode or hard failure mode. The system still worked as normal with the exception of this lamp illuminating. This was also caused by the fault-sensing circuitry operating on a threshold during the fast hop mode. Since this indication did not cause any problems with testing the system, it was decided not to change this threshold until Motorola had a chance to determine the component value required so as to not open this threshold window too wide. This problem was also corrected further into the testing program.

2. POWER INPUT VS POWER OUTPUT TESTS

A power in vs power out test was accomplished on both systems. The test configuration is shown in Figure 18. The results of this test are shown in Tables 4 and 5. Power was decreased until the 1 kw system went into the bypass mode. After finding the low power input threshold at each frequency, the power was slowly increased to 155 watts at each frequency. This resulted in a steady 1 kw output. Since the specified limits of the system are 50 to 150 watts, the systems operated well within these limits.

*This module interchangeability problem has been addressed by Motorola and a new BITE threshold technique has been designed and proven in a subsequent 400 watt system built for the Navy. This technique can be readily adapted in a production-type AN/ASC-31.

Motorola 1 Kw Power Amplifier

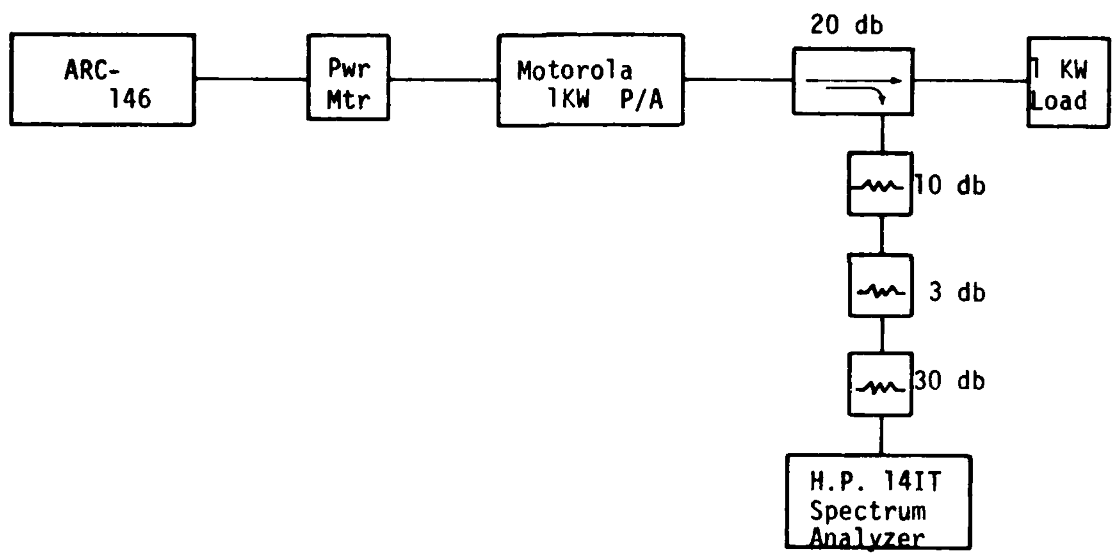


Figure 18. Power Input vs Power Output Test Configuration

TABLE 4

MOTOROLA 1 KW UHF AMPLIFIER S/N 001

FREQ (MHz)	POWER INPUT (Watts)*
225	55
230	50
240	43
249	32
260	25
270	17
280	15
290	15
300	15
310	15
320	15
330	15
340	15
349	15
360	15
370	15
380	15
390	15
399	15

TABLE 5

MOTOROLA 1 KW UHF AMPLIFIER S/N 002

FREQ (MHz)	Power Input (Watts)*
225	30
230	28
240	29
249	33
260	35
270	38
280	38
290	33
300	35
310	35
320	34
330	33
340	33
350	33
360	33
370	32
380	32
390	32
399	32

*The power level indicated is the minimum level acceptable and still obtain a 1 KW output. Any level above this provides a 1 KW output. Any level below this the unit goes into the bypass mode.

It was noted during these tests that the driver light will illuminate with a key signal, but no RF drive into the 1 kw system. Thus the driver-light indicates a key situation, but does not show that there is an RF signal present as would be assumed by the light.

3. SATELLITE TESTS

An operation test was accomplished by using the 1 kw system to transmit messages from the dual modem system via the LES 9 satellite and copy them on the single UHF modem, Figure 19. This was successfully accomplished in both LES-hopping modes of the dual modem (a 200 msec and a 5 msec hopping rate). The messages were passed with 100% copy on the single UHF modem (Figure 20). The only abnormal indication noted during this test was a decreased output level. During the 200 msec hopping rate the power output was 825 watts and during the 5 msec hopping rate the power output was 750 watts. The dim fault light during the fast hop mode of operation was observed as noted in earlier tests, but did not appear to affect the operation of the system, and was corrected in the bite circuitry later in the testing program.

4. INTERMODULATION PRODUCTS MEASUREMENT

To accomplish this test, two separate AN/ARC-171 transmitters with their associated Dual Modems were used to generate two CW's that were combined with a 90° Hybrid and inserted into the AN/ASC-31 system (Figure 21). A second portion of the test utilized the two separate AN/ARC-171 transmitters and two UHF synthesizers (HP8660B) as drivers for finer tuning of the drive frequencies (Figure 22). In both test setups, the output of the AN/ASC-31 system was fed into a 1 kw dummy load. Utilizing a 60 db down tap on the load, the signal was monitored with a spectrum analyzer (HP8566A). As can be seen in Figures 21 and 22, the output levels of the two AN/ARC-171 transmitters were not matched. Consequently, a tunable 100 watt amplifier was inserted at the output of AN/ARC-171 #2 and tuned to balance the two RF outputs entering the 90° hybrid. Figure 23

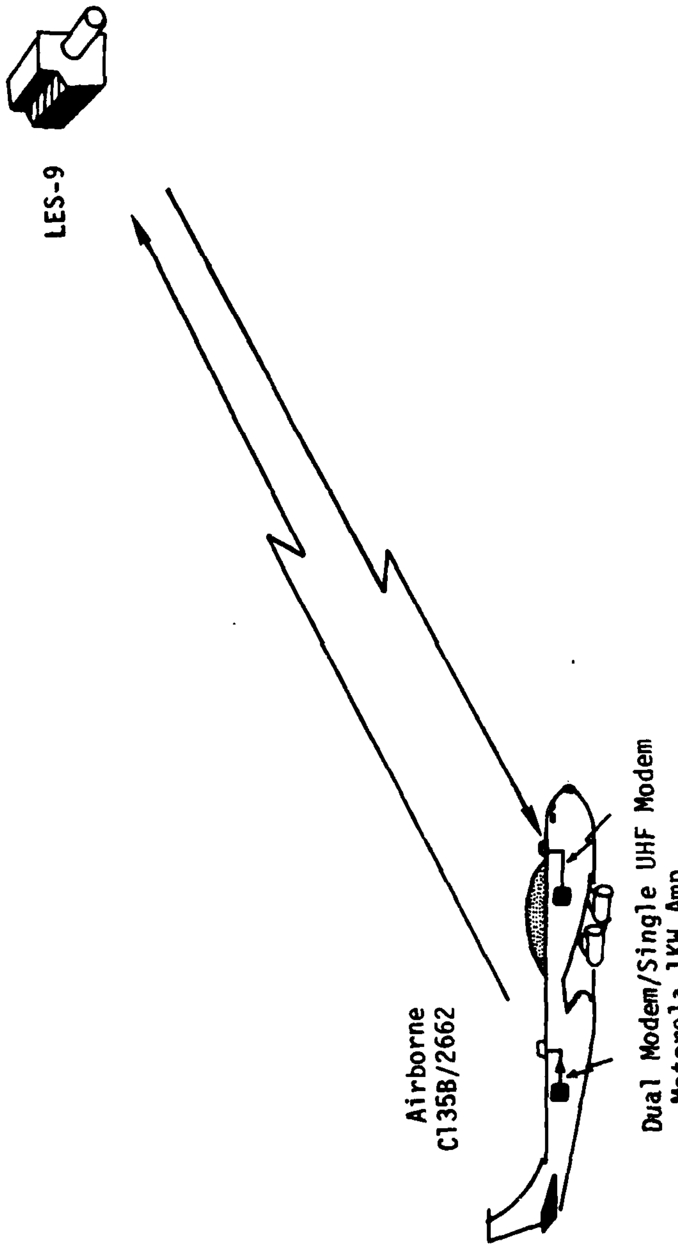


Figure 19. LES Hopping Frequency Test Configuration

```
THIS IS A TEST OF THE 1KW FAST HOP
THIS IS A TEST OF THE 1KW FAST HOP
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THIS IS A TEST OF THE 1KW FAST HOP
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Figure 20. Messages Passed at the Fast Hopping Rate

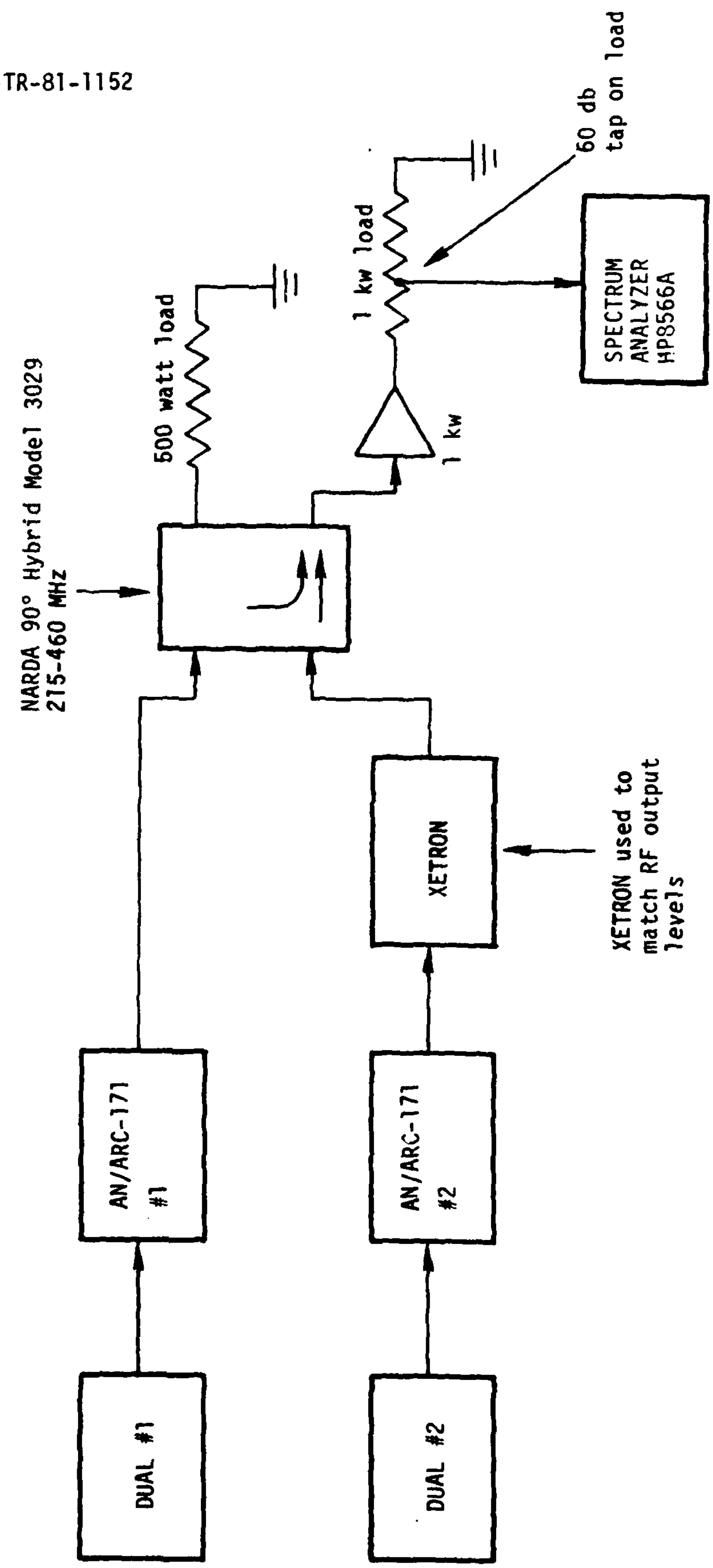


Figure 21. First Test Configuration

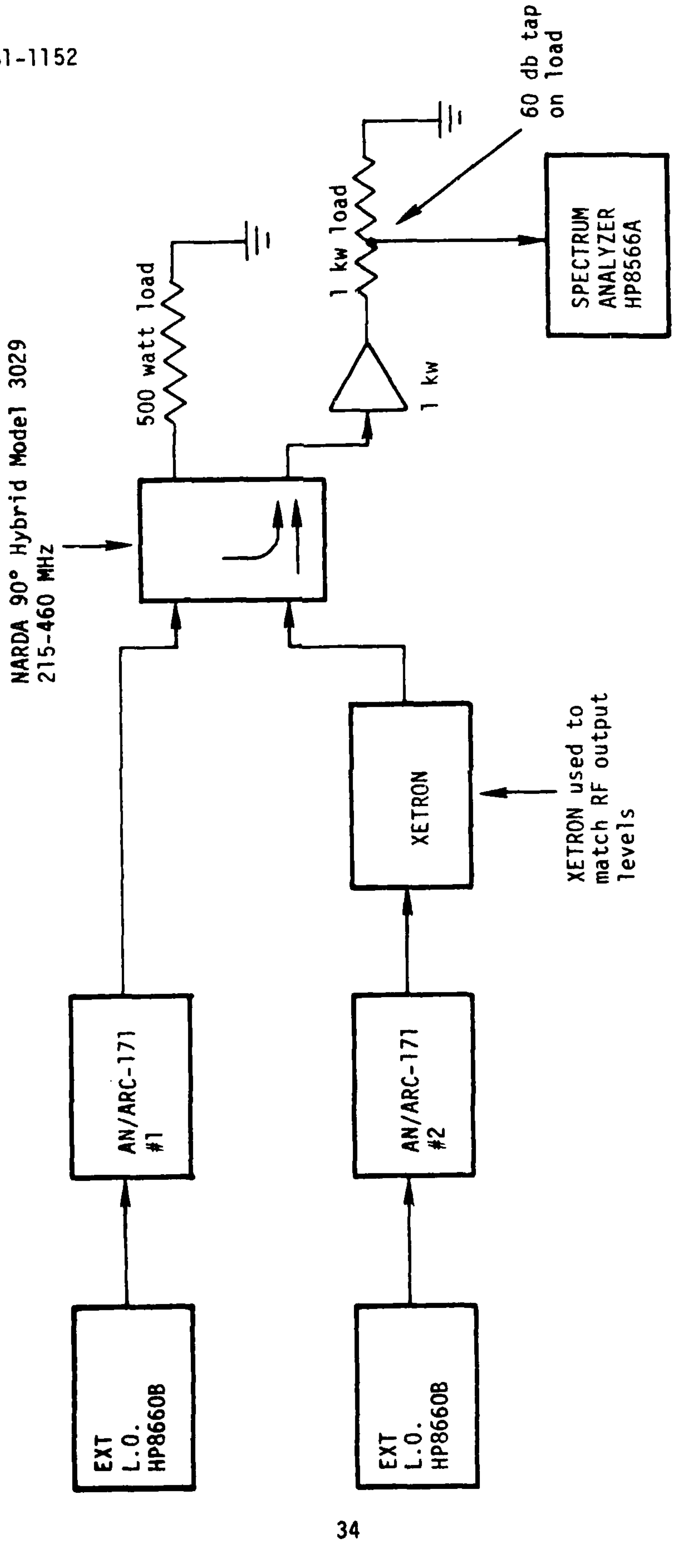
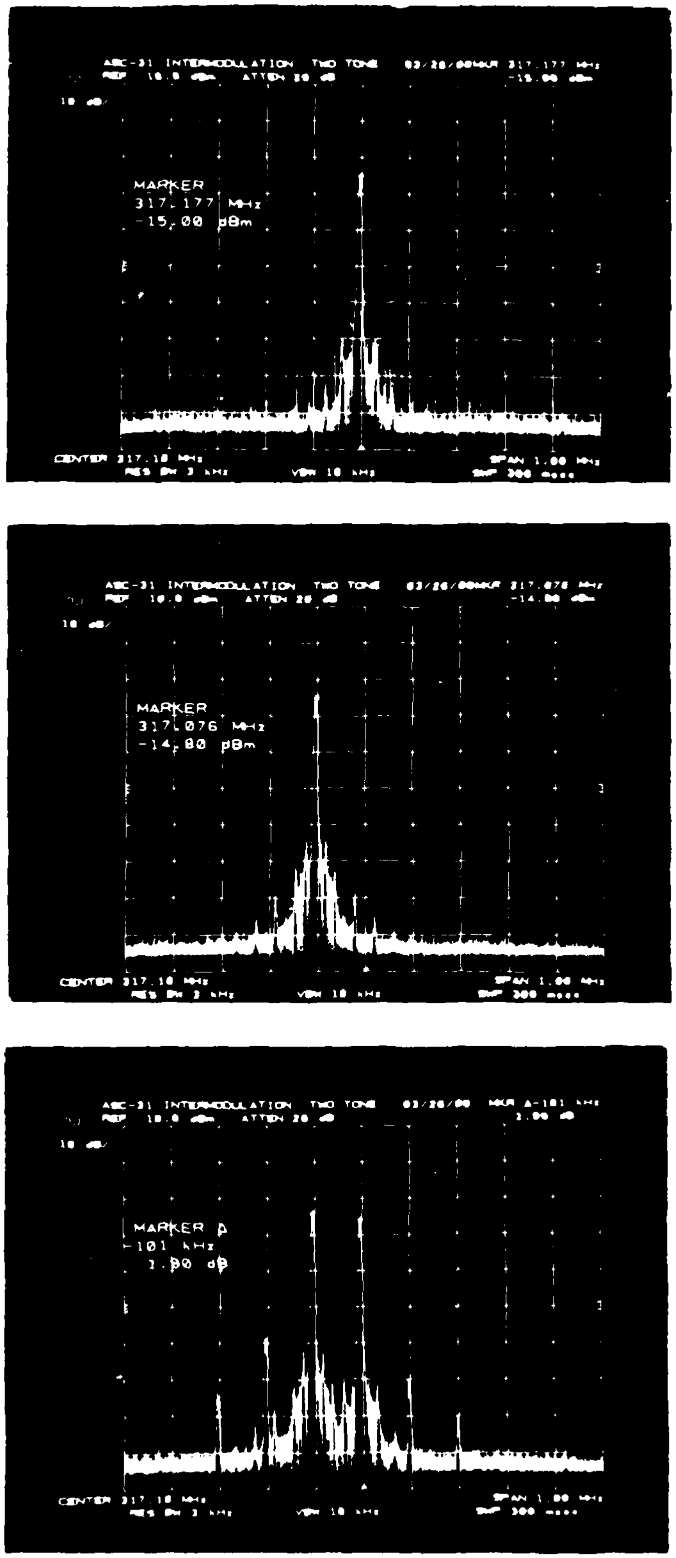


Figure 22. Second Test Configuration



A. DUAL #1

No kw
Frequency Plan B
Channel #6

B. DUAL #2

No kw
Frequency Plan A
Channel #6

C. The two AN/ARC-171 RF outputs after the combiner.

Signal spacing = 101 kHz

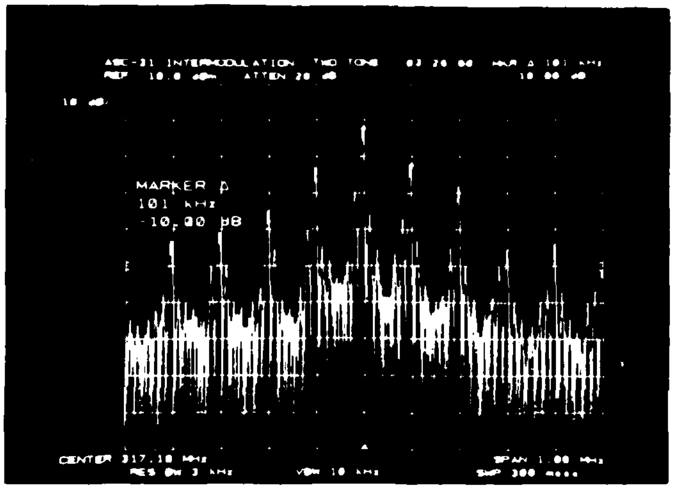
Figure 23. AN/ARC-171 RF Outputs (First Test Configuration)

(A & B) shows the two RF outputs of the two AN/ARC-171 radios. The two frequencies were standard FLEETSATCOM frequencies, 100 kHz apart with no modulation. To accomplsih this, the 70 MHz IF was disconnected from the AN/ARC-171. These two RF CW signals were then combined as depicted in Figure 21; and Figure 23 (C) is a photograph of the two combined RF signals prior to entering the AN/ASC-31 system. Figure 24 (A & B) are photographs of the 1 MHz wide output spectrum of the AN/ASC-31 while injecting two combined RF signals. A marker is placed on the first tone on either side of the center frequency, indicating these frequencies to be 101 kHz either side of the center frequency. Figure 24 (C) is the same output of the AN/ASC-31 looking at the 5 MHz spectrum.

The same test was then accomplished again with the exception that the two RF signals were spaced 5 kHz apart, thus adjacent channel frequencies of FLEETSATCOM. Figure 25 (A) shows the two signals at the input of the AN/ASC-31. Figures 25 (B and C) and 26 (A, B, and C) are the RF output of the AN/ASC-31 looking at spectrum widths of 100 kHz, 1 MHz, 5MHz, 10 MHz and 20 MHz, respectively. Figures 27 (A and B) are the same output only looking at a frequency span of 225 to 375 MHz and 225 to 425 MHz, i.e., across the entire UHF frequency band.

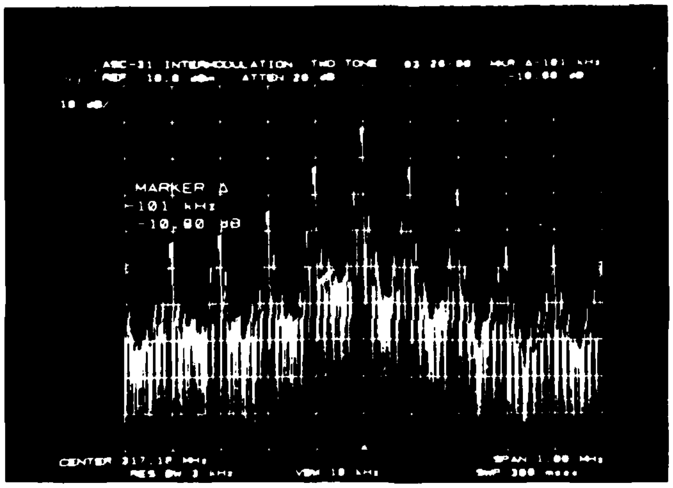
At this point it was determined to look at two RF signals separated by 1.25 kHz. To accomplish this, external IF frequencies were injected into the two AN/ARC-171's utilizing HP8660B synthesizers as shown in Figure 3. One synthesizer centered at 70.0 MHz and the other at 70.125 MHz. Figures 28 (A and B) are displays of the spectrum at the output of the AN/ASC-31 system at 100 kHz and 10MHz span widths.

The AN/ARC-171's 70 MHz IF's were then reconnected to their appropriate Dual Modems. System #1 was then set up to transmit on FLEETSATCOM frequency plan "B" channel #11, and system #2 set up on FLEETSATCOM frequency plan "B" channel #10. Thus the two systems are now 5 kHz apart (adjacent channels) and both systems were modulated. The remainder of the test configuration remained the same as previously utilized. Figure 29 (A and B) displays the AN/ASC-31 RF output at spectrum span widths of 10 and 20 MHz.



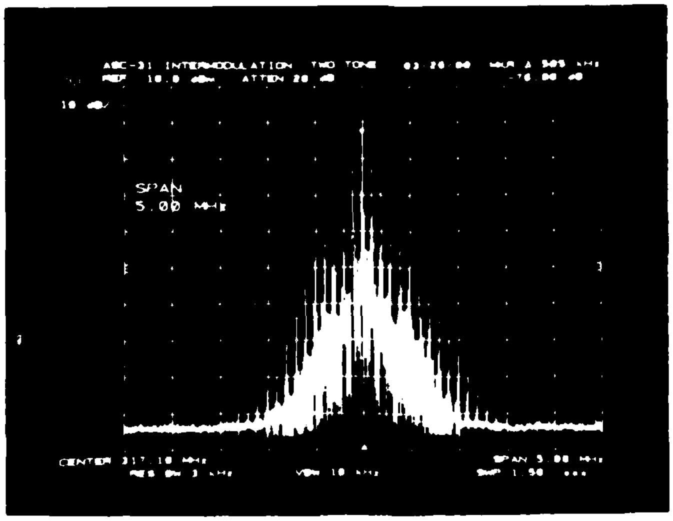
A.

Markers = 101 kHz
Frequency span = 1 MHz



B.

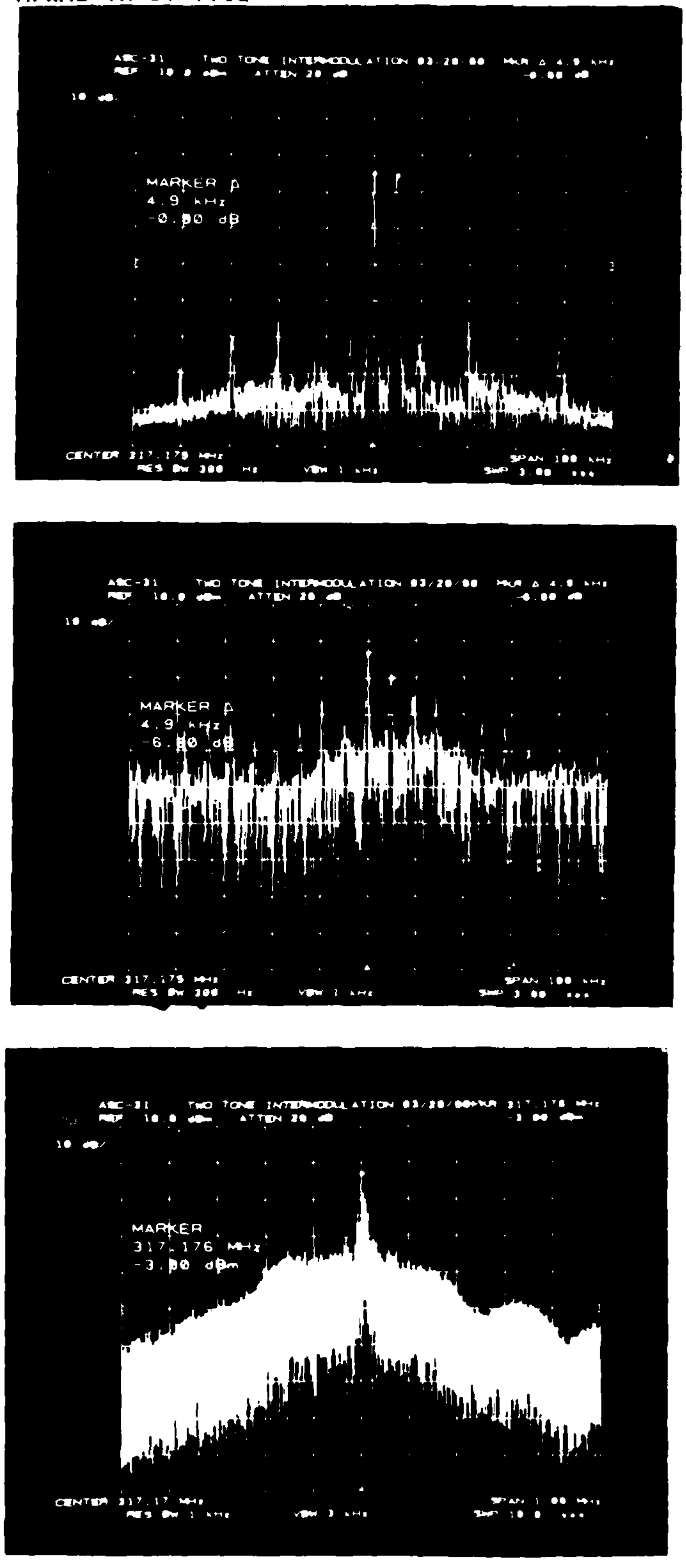
Markers = -101 kHz
Frequency span = 1 MHz



C.

Markers = 500 kHz
Frequency span = 5 MHz

Figure 24. Output Spectrums of the 1 Kw with the Combined AN/ARC-171 Signals (First Test Configuration)



A. AN/ARC-171 RF outputs combined

Signal spacing = 5 kHz

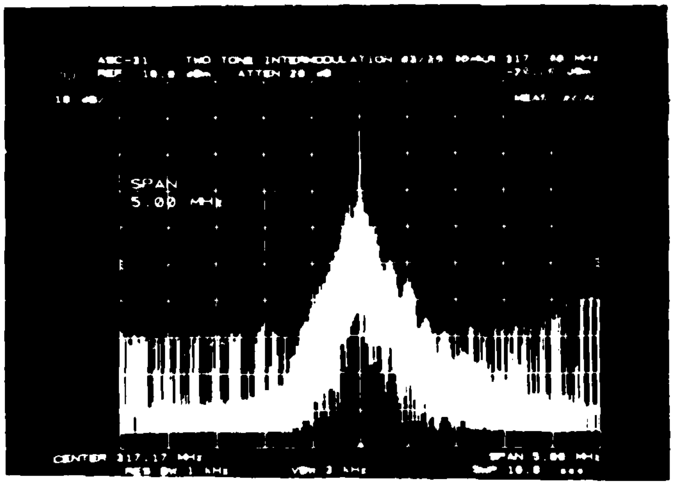
B. Output Spectrum of AN/ASC-31 with Combined RF Inputs

Frequency span = 100 kHz
Signal spacing = 5 kHz

C. Output Spectrum of AN/ASC-31 with Combined RF Inputs

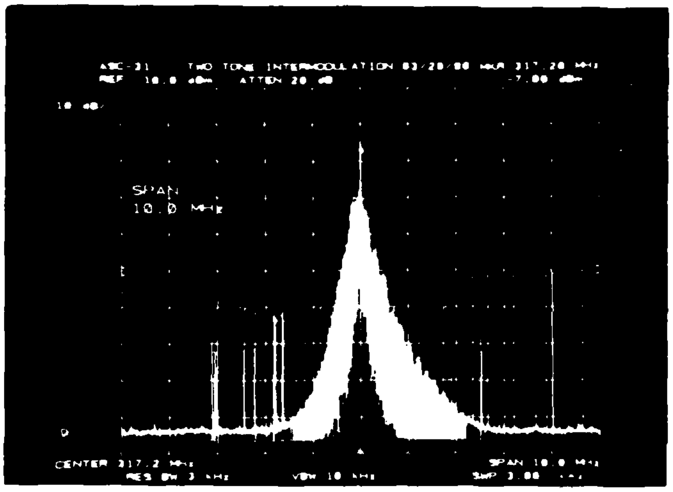
Frequency span = 1 MHz
Signal spacing = 5 kHz

Figure 25. AN/ARC-171 RF Outputs Combined/Output Spectrums of AN/ASC-31 with Combined RF Inputs (First Configuration 5 KHz Spacing)



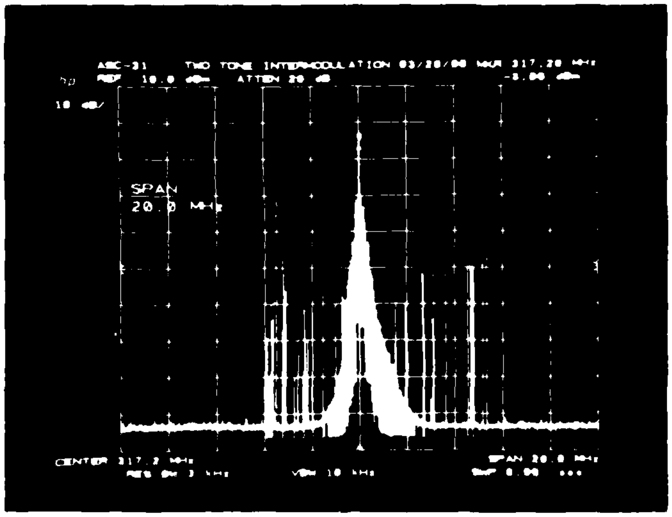
A.

Frequency span = 5 MHz
Signal spacing = 5 kHz



B.

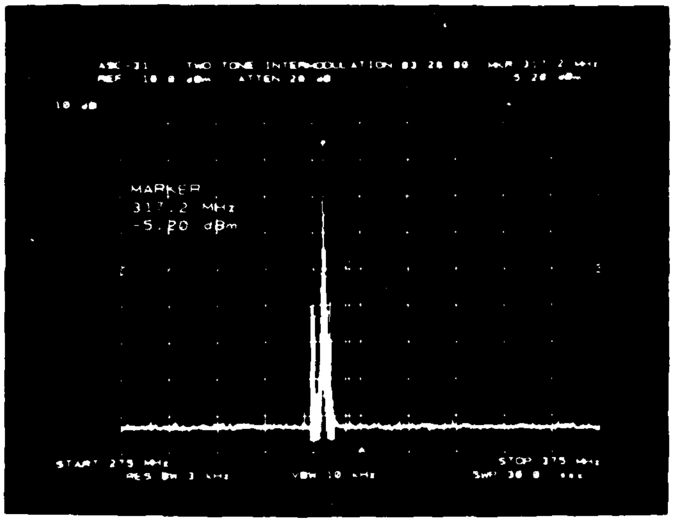
Frequency span = 10 MHz
Signal spacing = 5 kHz



C.

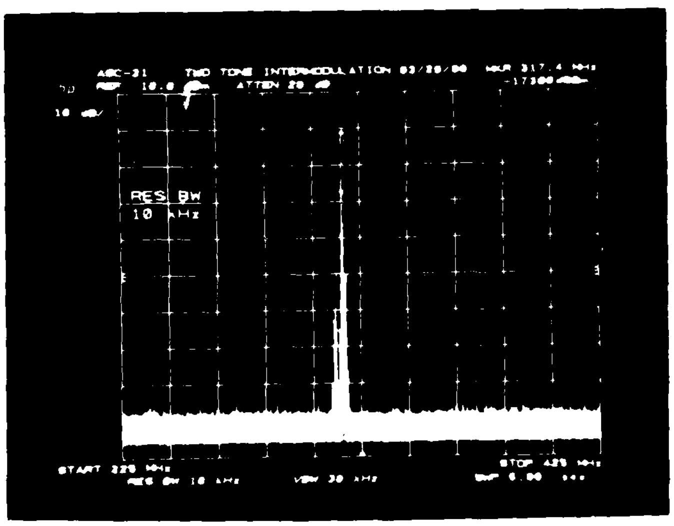
Frequency span = 20 MHz
Signal spacing = 5 kHz

Figure 26. Output Spectrums of AN/ASC-31 with Combined RF Inputs (First Test Configuration with 5 KHz Spacing)



A.

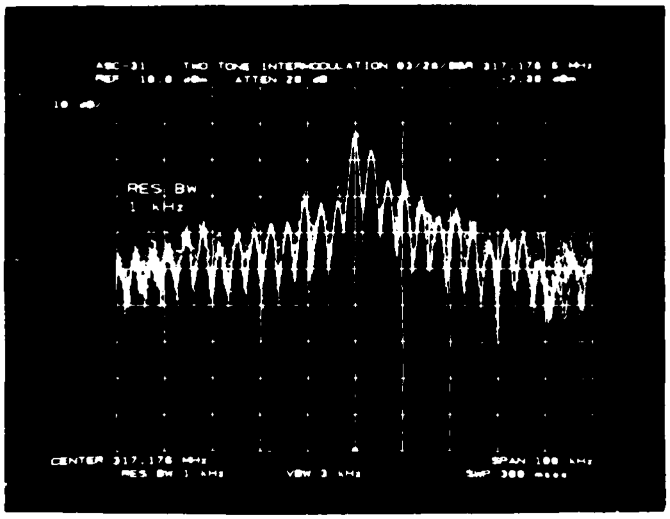
Frequency span = 275-375 MHz
Signal spacing = 5 kHz



B.

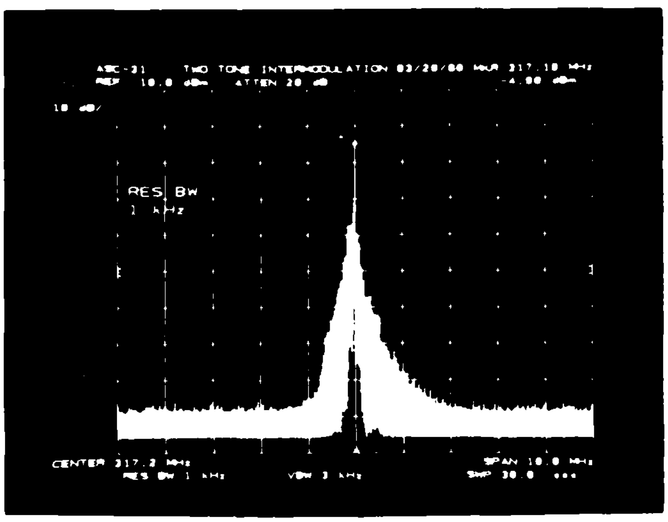
Frequency span = 225-425 MHz
Signal spacing = 5 kHz

Figure 27. Output Spectrums of AN/ASC-31 with Combined RF Inputs (Second Test Configuration)



A.

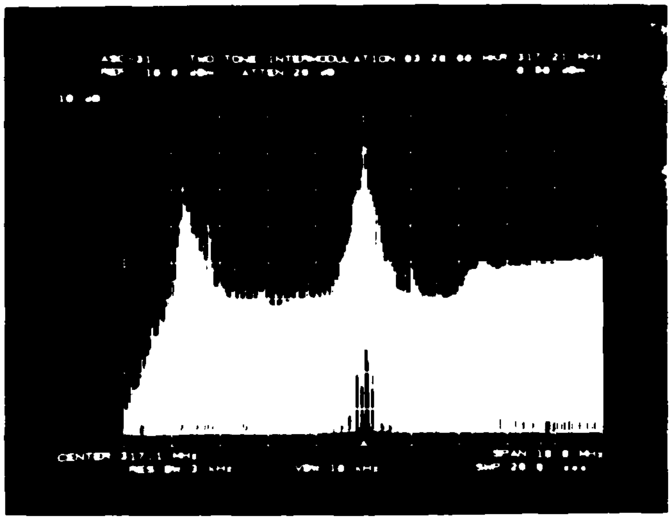
Frequency span = 100 kHz
Signal spacing = 1.25 kHz



B.

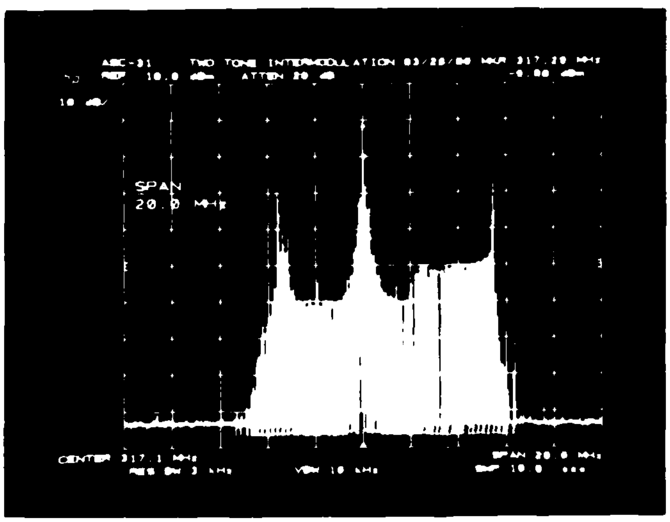
Frequency span = 10 MHz
Signal spacing = 1.25 kHz

Figure 28. Output Spectrums of AN/ASC-31 with Combined RF Inputs (Second Test Configuration)



A.

Dual Modems SSTAT:
Dual #1 = B-11
Dual #2 = B-10
(modulated)
Frequency span = 20 MHz



B.

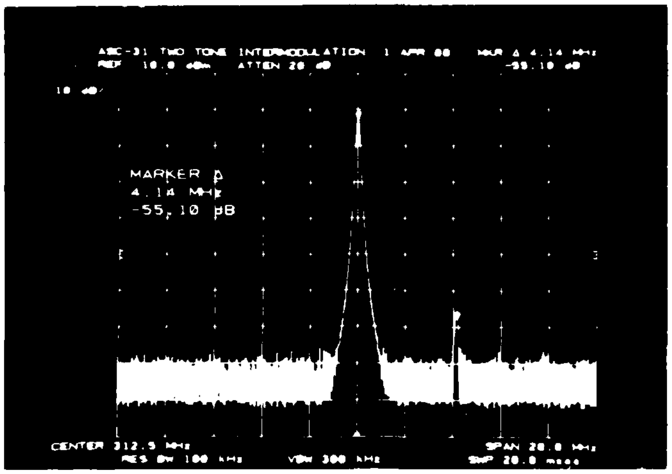
Dual Modems SSTAT:
Dual #1 = B-11
Dual #2 = B-10
(modulated)
Frequency span = 20 MHz

Figure 29. Output Spectrums of AN/ASC-31 Combined RF Inputs and Dual Modems

The 70 MHz IF's on the AN/ARC-171's were again disconnected from the Dual Modem systems and reconnected to the HP8660B synthesizers. With this accomplished, the two synthesizers were set up unmodulated and 4.1 MHz apart. Figure 30 (A) shows that the filter internal to the AN/ASC-31 tuned to the commanded frequency, and reduced the output of the second CW signal approximately 55 db with no intermod products noticeable. Figure 30 (B) is the same set up, with the synthesizer frequencies separated by 2 MHz. In this photograph it can be seen that the tunable filter has decreased the second CW signal by approximately 55 db and an intermod product is visible. With the test setup remaining unchanged, the synthesizers were then tuned to a 620 kHz separation between their outputs. As can be seen in Figure 30 (C), the second CW is now on the edge of the 1 MHz band pass of the tunable filter and thus it is reduced by approximately only 25 db, and more intermod products are showing up.

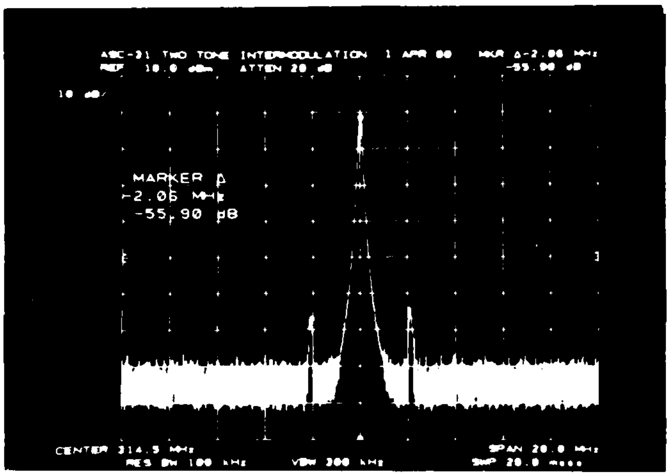
5. THERMAL TEST

A thermal test was conducted on the AN/ASC-31 with it driven by the AN/ARC-171 Transceiver/Dual Modem in the AFSAT mode. The AFSAT mode simply being a 2-tone FSK signal with 2.5 kHz spacing between tones, operating at a 75 bps rate. This was as close to a constant CW signal as possible with the existing systems. The Test Configuration is shown in Figure 31. The Test was conducted on Board the C13513/2662 aircraft with the aircraft stationary on the ground. Prior to system turn-on, thermometers were placed within the cabin. One was placed approximately 8 feet away from the 1 kw Power Amplifier unit, to measure cabin temperature; another was placed approximately 6" in front of the cooling inlet grill to measure inlet coolant air temperature. A thermocouple was placed 1-2 inches directly behind the exhaust blower at the rear of the three 400 watt modules. After system turn-on, a third thermocouple was then placed on the front of each of the three 400 watt modules chassis. Due to the physical difficulty of attachment of this third thermocouple without disturbing the inherent air flow design, this thermocouple was hand placed on each module and allowed to stabilize approximately every 5-15 minutes for these measurements. Air distribution of the AN/ASC-31



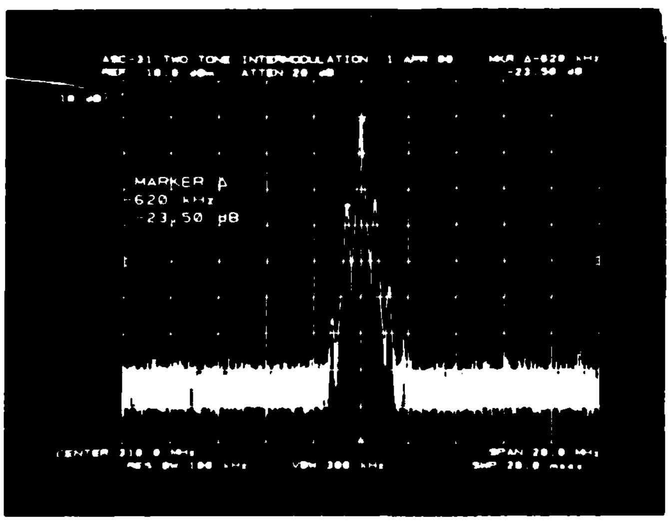
A.

Frequency spacing = 4.1 MHz



B.

Frequency spacing = 2 MHz



C.

Frequency spacing = 620 kHz

Figure 30. Output Spectrums of AN/ASC-31 with Combined CW Signals from HP8660B Synthesizers

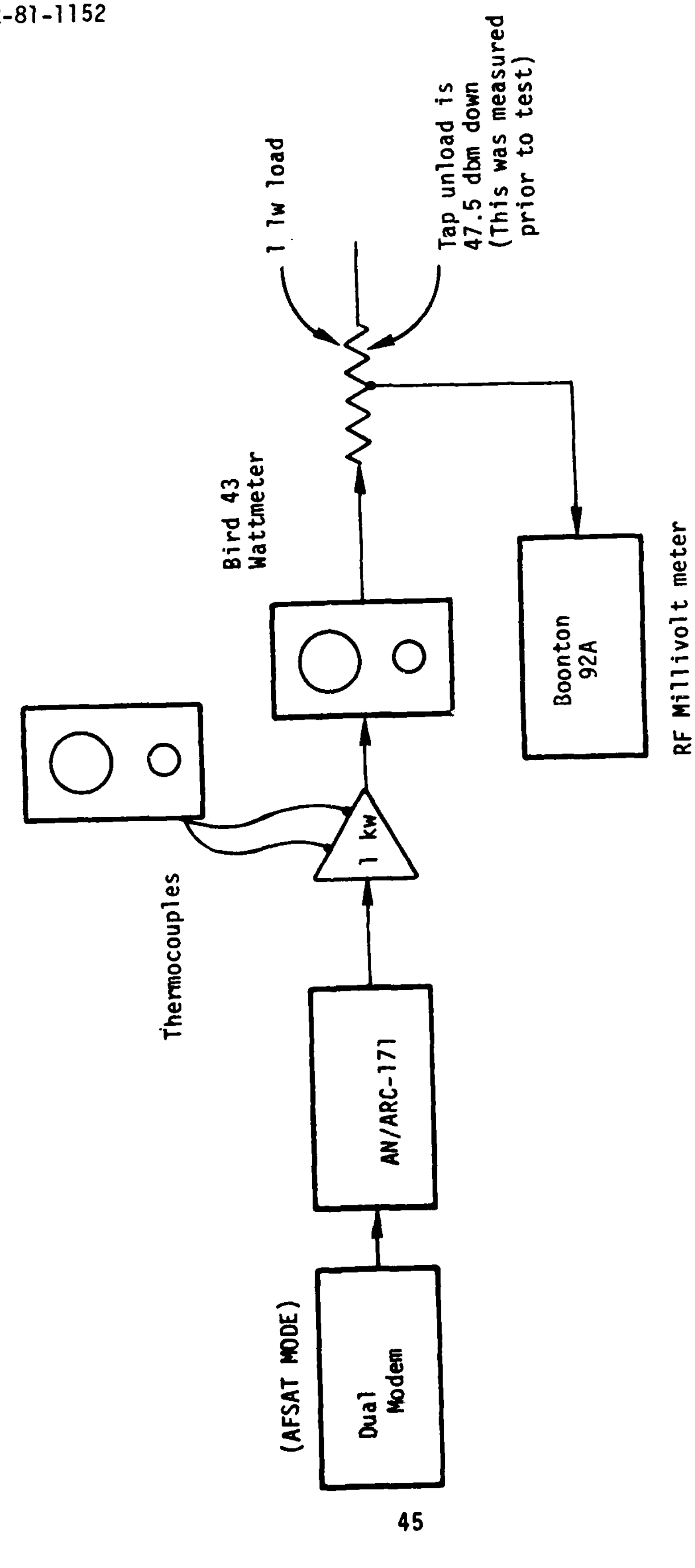


Figure 31. Thermal Test Configuration

system is depicted in Figures 33 and 34. Assuming the power amplifier to be the critical portion of the system, no thermal measurements were conducted on the power supply unit at this time. The RF drive Power Level from the AN/ARC-171 during this test remained constant at 56 watts. The RF output level of the AN/ASC-31 was simultaneously measured with a Bird Model #43 thruline watt-meter, a Boon Ton Model 92 RF millivolt meter and the AN/ASC-31 RF output level meter on the remote control head. The two external power monitors indicated 625 watts during the majority of this test while the internal system monitor during this same period indicated 850 watts output. On two short duration occasions during this test, the power output level dropped sharply by 100 watts as indicated on all three power level monitors (Thruline and RF millivolt meter, 525 watts; internal system monitor; 750 watts). There was no apparent reason that the AN/ASC-31 did not transmit at a full 1 kw and/or that the system output power level dropped by 100 watts on two occasions. Results of the thermal test are shown in Figure 35.

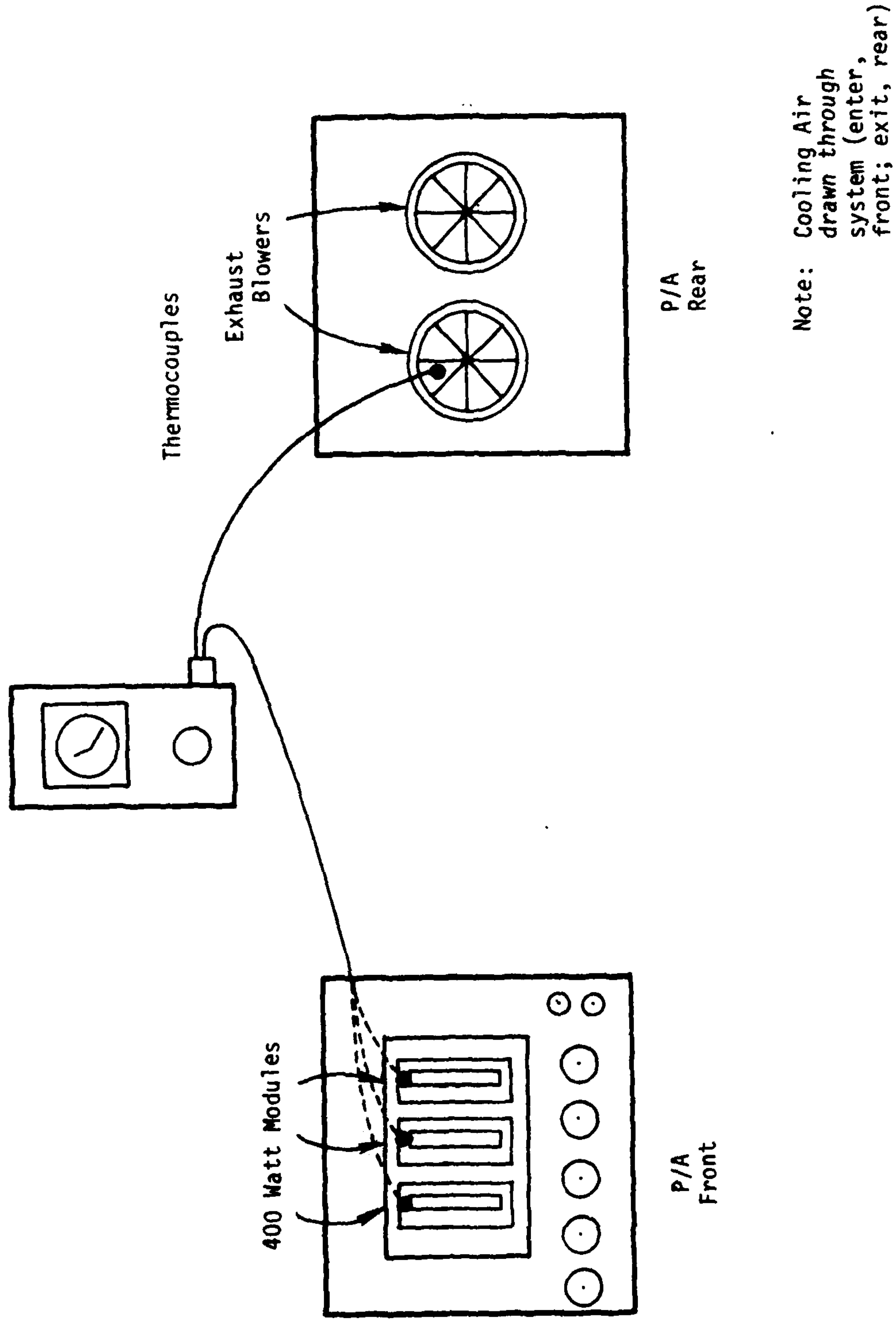


Figure 32. Thermocouple Placement on P/A

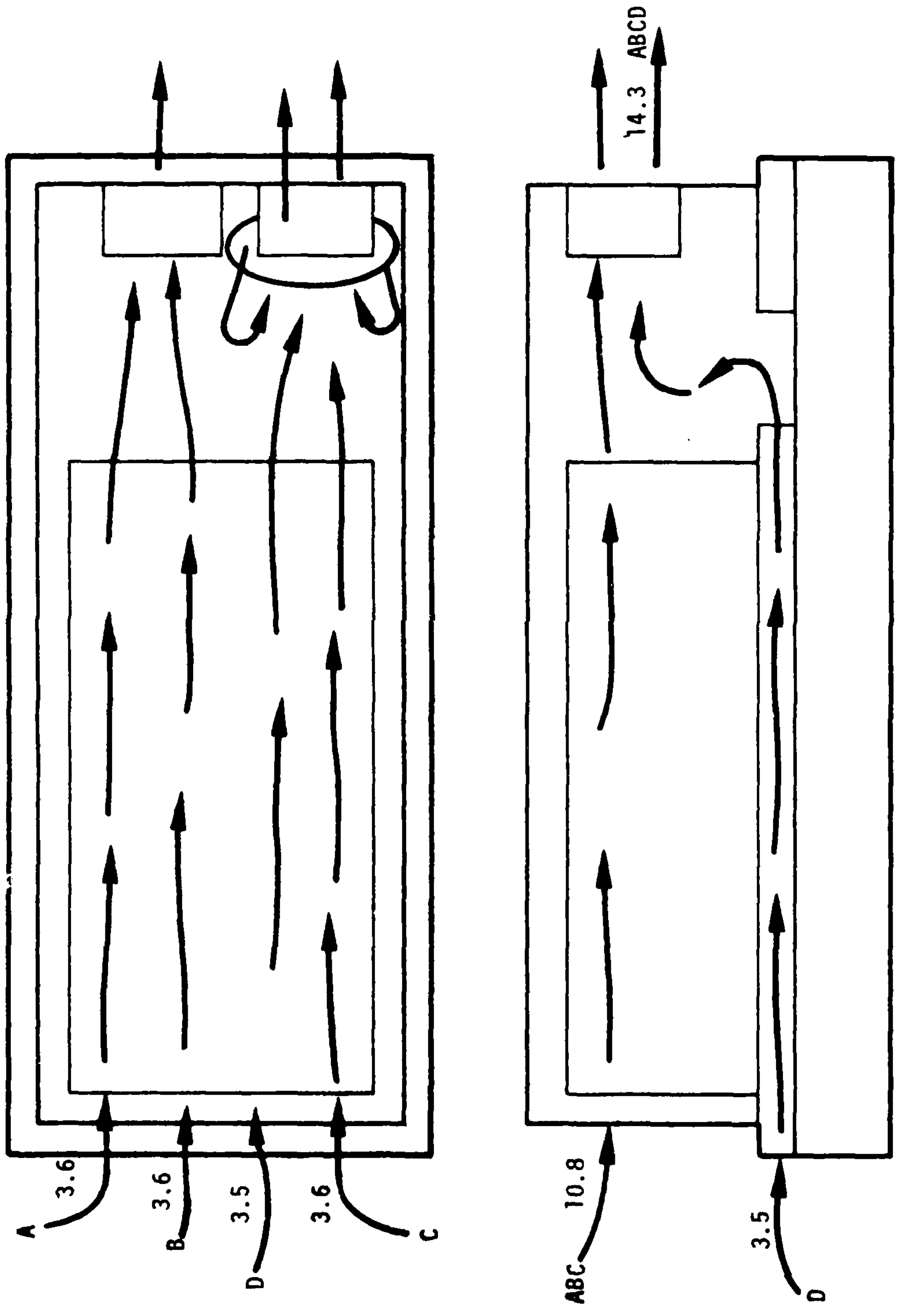


Figure 33. Power Amplifier Air Distribution (Nominal Sea Level 71°C)

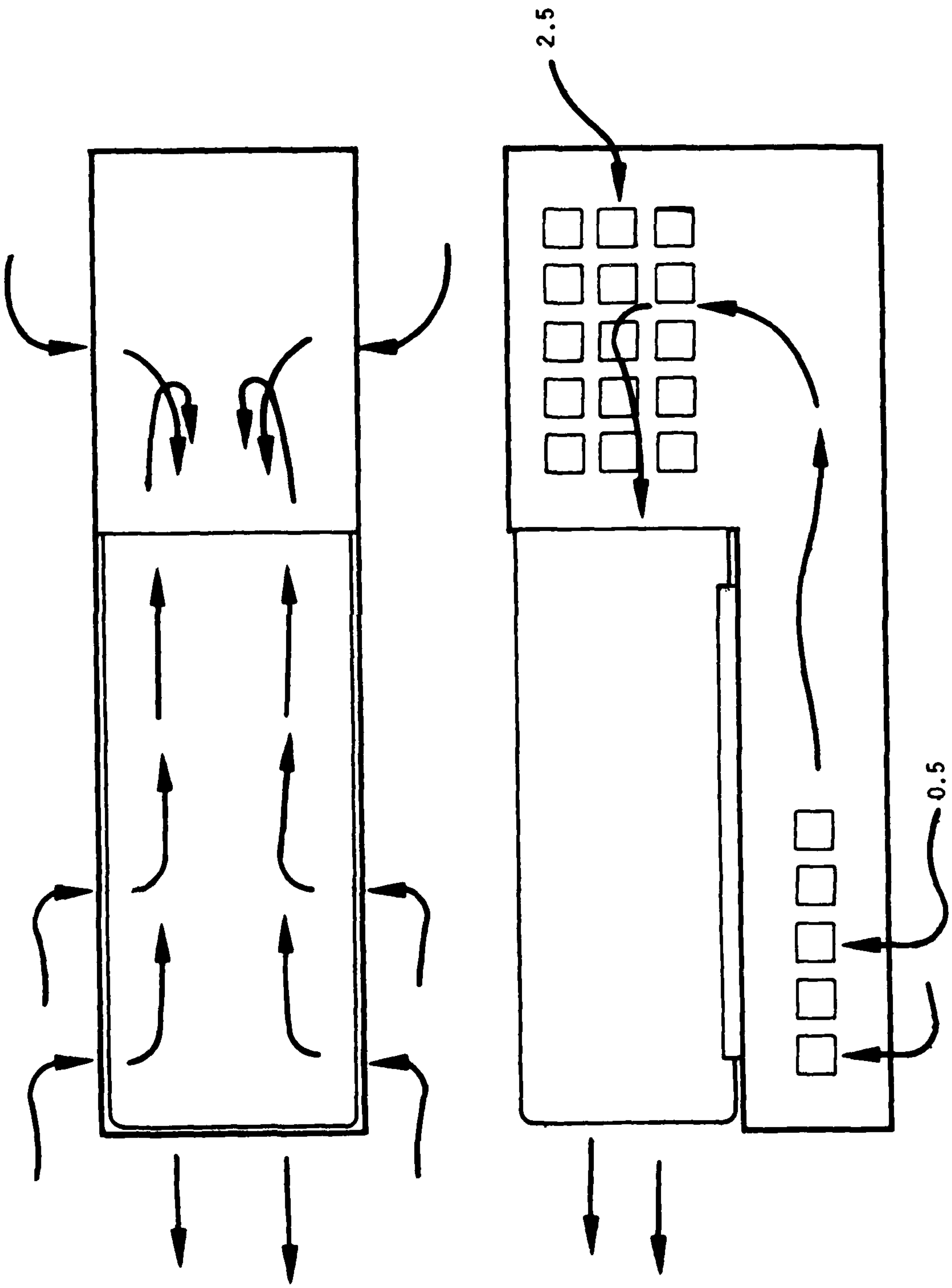


Figure 34. Power Supply Air Distribution (Nominal Sea Level 71°C)

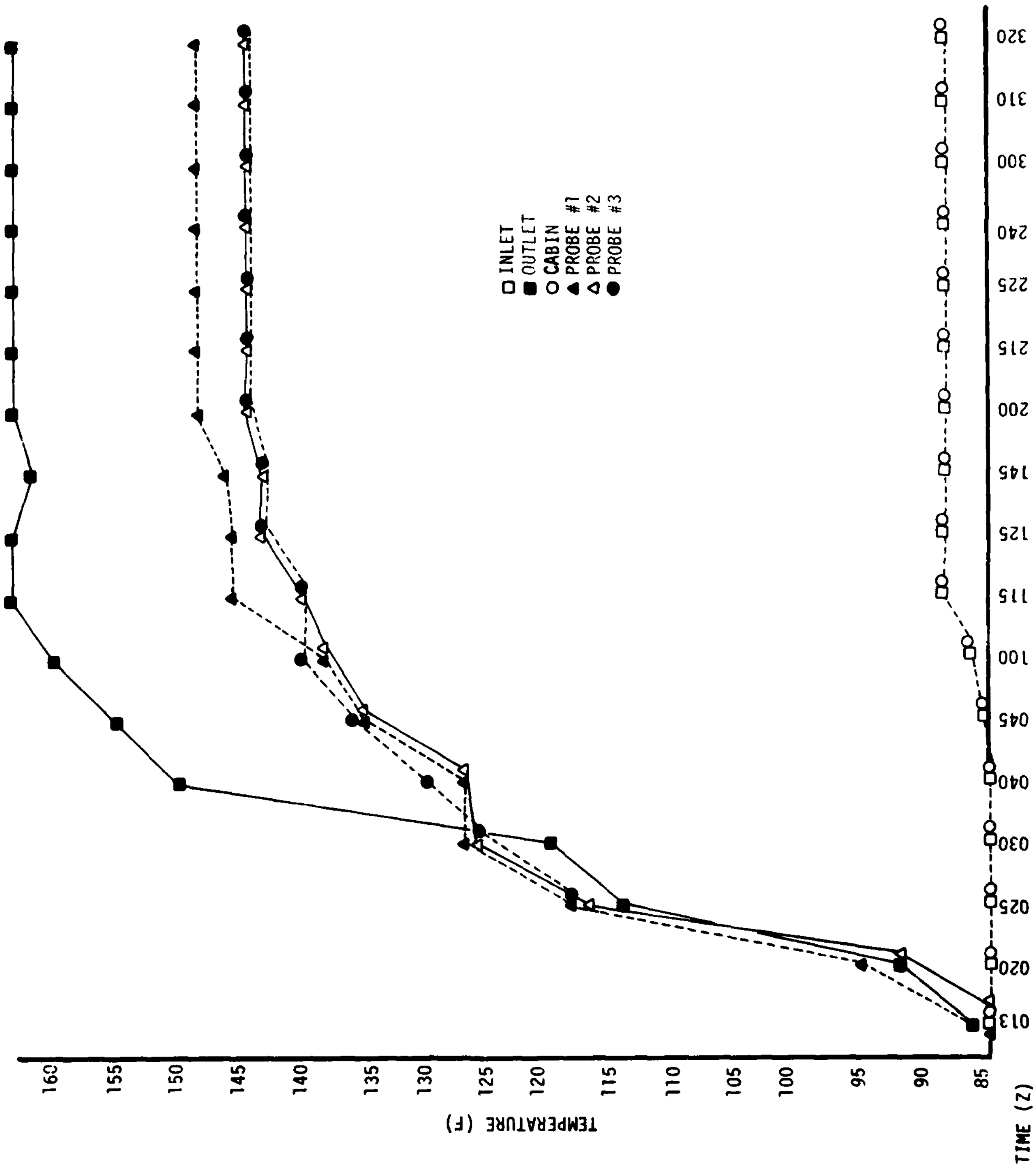


Figure 35. 1 Kw Thermal Test

SECTION IV

SUMMARY AND CONCLUSIONS

Increasing the anti-jam capability of present UHF Hopping Satellite Communications systems without causing interference with collocated systems by radiating broadband noise was the primary reason for this development. The test of this system demonstrated that this system (AN/ASC-31) is capable of meeting this requirement.

With a minimum amount of wiring, the AN/ASC-31 system can be easily adapted to an existing AN/ARC-171, i.e., Dual Modem system as shown in Figure A-1 and Table A-10.

Due to the size and weight of the Power Amplifier unit and the system power supply unit, these two units may be located within any available part of the aircraft. Due to the high noise level of the 400 Hz coolant blowers within these two units, it is recommended that they not be mounted within an operators area. The remote control panel would allow an operator to control and monitor the system.

A GO-NO-GO indication of the system would be apparent to an operator with the indicator lights and system BITE monitor on the Remote Control Head. A problem within the system can be readily diagnosed with the bite monitor and permanentily affixed reference card built into the Remote Control Head.

The amplifier is designed with 16 identical amplifier modules. Each of these module's minimum power output is 120 watts without any tuning or adjustment. Therefore any of these modules may be used interchangeably as a preamplifier, driver, or an output amplifier. All the modules in the power amplifier are plug-in type and can be removed by removal of the mounting screws. This modular design lends itself well to an operational repair environment.

The AN/ARC-171, i.e., Dual Modem system is operated normally in the receive mode while interconnected with the AN/ASC-31, thus it is concluded that any receive loss within the AN/ASC-31 is negligible as expected.

Considering the fact that the AN/ASC-31 system was not designed to operate with multiple input RF signals, the system is susceptible to intermod problems once the two incoming CW signals are separated by 2 MHz and closer. This could cause problems if adjacent FLEETSATCOM frequency plans, or adjacent 5 kHz channels within a given frequency plan, were attempted. If the two signals were modulated, the problem is compounded.

Operationally, the system's elapsed time meter and primary power switch are physically located on the wrong units. The elapsed time meter is presently located on the remote control head. Either each unit should have its own elapsed time meter or the power amplifier unit should have the elapsed time meter since it is the heart of the system. The system primary power switch is presently located on the power amplifier unit and from an operational view it should be located on the remote control head. Conceivably, the power amplifier unit would be mounted aboard an aircraft in an unaccessible area for personnel to conveniently control power; thus in the present position the system power would be controlled by the turn on/off of aircraft power which is undesirable.

A particularly critical portion of the fault detection circuitry seemed to be when the fault thresholds of all the 400 watt modules within a system are at the same level. The two systems utilized in tesing did not have an identical overall threshold between systems, thus it was not possible to interchange a couple of the 400 watt modules between systems. The mechanism causing this problem is understood and particular care should be exercised to insure that all these fault thresholds within all systems are identical.

APPENDIX

XETRON FILTER INTERFACE DETAILS

TABLE A-1

EXTERNAL INTERFACE TO AN/ARC-171

1 KW CONTROL
CONN. J4

	FUNCTION	CONNECT TO AN/ARC-171
1	Key	J6-37
2	Inhibit Arc	J6-38
3	AM/FM	
4	200/300 MHz Sel	J6-2
5	Ground	J6-30
6		
7	8 MHz Sel	J6-9
8	4 MHz Sel	J6-13
9	2 MHz Sel	J6-14
10	1 MHz Sel	J6-15
11	Ser. Cont. H.	J6-4
12	Ser. Cont. L.	J6-5
13	Shield For 11-12, 14-15	J6-11
14	Cont. Clock H.	J6-18
15	Cont. Clock L.	J6-19
16	Parallel Pre-Empt	Tied Backat 1KW (must be high or open to operate LES mode)
17	80 MHz Sel	J6-3
18	40 MHz Sel	J6-6
19	20 MHz Sel	J6-7
20	10 MHz Sel	J6-8
21		
22		
23		
24		
25	Los Serial Data H.	J5-4
26	Los Serial Data L.	J5-5
27	Shield For 25-26, 28-29	J5-11
28	Los Clock H.	J5-10
29	Los Clock L.	J5-18
30	Norm/Hi Speed	J6-12
31	Los Pre-Empt	J5-25 J5-6 } Jumpered Together

Figure A-1. 1 KW (AN/ARC-31)/AN/ARC 171 Interface

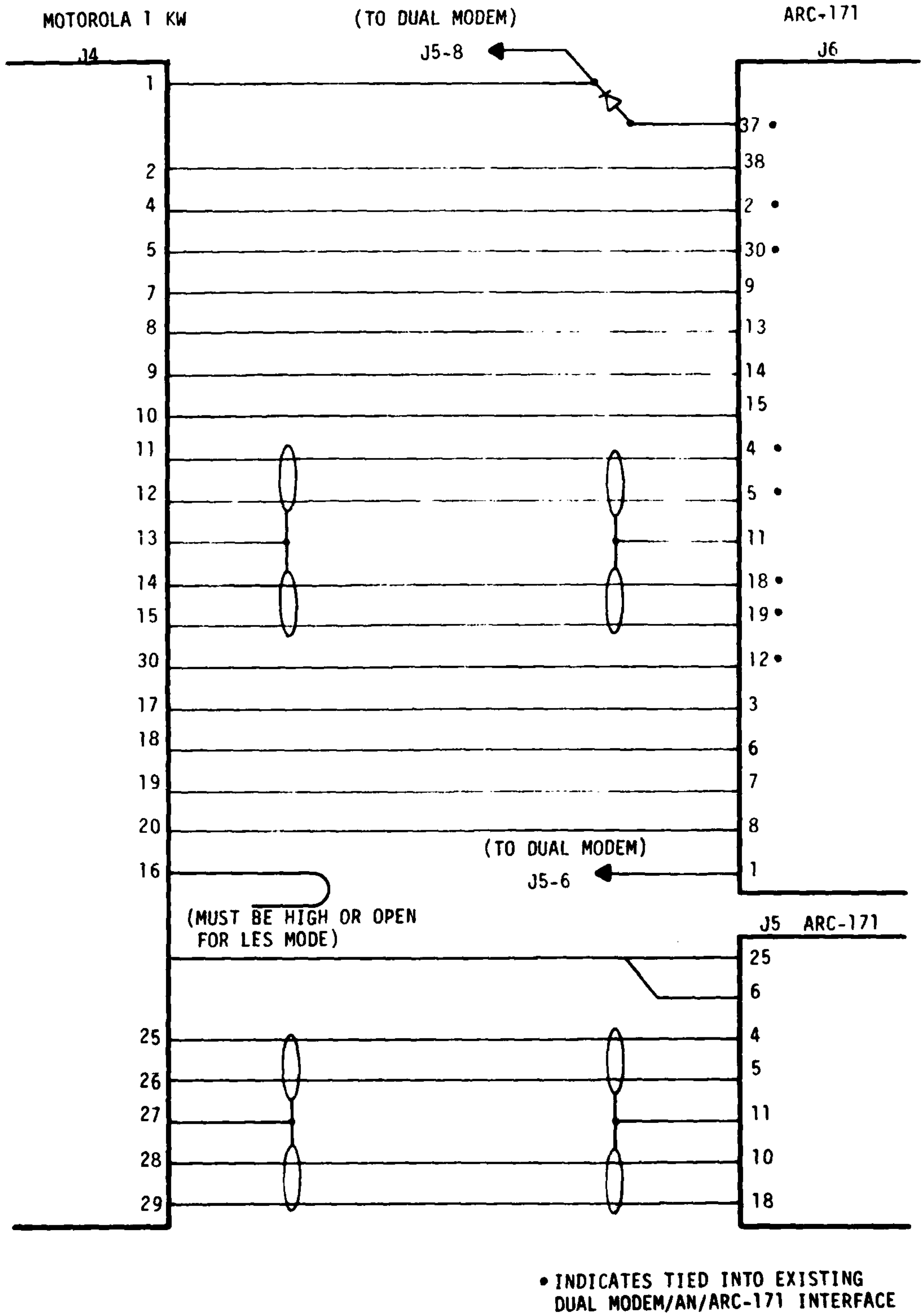


TABLE A-2

INTERFACE CONNECTOR

PIN	FUNCTION	DESCRIPTION
2, 21	+28 VDC	24 to 29 VDC @ 7 Amps
19	Spare	
5, 23	Power Ground	DC Return
30	Norm/High Speed	1 kHz Data Rate = 10 ±3 VDC Or Open 6 kHz Data Rate = 1/2 ± 1/2 VDC
1, 20	Spare	
4	+12 VDC	+12 VDC ± 5% @ 2 Amps
22	-12 VDC	-12 VDC ± 5% @ 3 Amps
3	+50 VDC	+50 VDC ± 5% @ 1 Amps
37	Key Line	Transmit = TTL High Receive = TTL Low
24	Temperature Sense	RTH-33ES332K Thermistor To Ground
17	Filter Tune	Tuned = TTL High Untuned = TTL Low
18	Filter Fault	Good = TTL High Fault = TTL Low
6	Chassis Ground	

TABLE A-3

UHF PARATUNE INTERFACE CONNECTOR

PIN	FUNCTION	LOGIC LEVEL OR NOM SIG LEVEL FOR FUNCTION DESIGNATED									
31	LOS Preempt	GND = LOS Preempt Open Or 10-30 VDC = Not LOS Preempt									
		Parallel Freq Control Lines Logic "0" = 1/2 ± 1/2 VDC. Logic "1" = 10 ±3 VDC Or Open									
		200					300				
32	200/300 MHz Sel	0					1				
	Decimal Freq (10 MHz) Control	0	1	2	3	4	5	6	7	8	9
33	80 MHz Sel	0	0	0	0	0	0	0	0	1	1
34	40 MHz Sel	0	0	0	0	1	1	1	1	0	0
35	20 MHz Sel	0	0	1	1	0	0	1	1	0	0
36	10 MHz Sel	0	1	0	1	0	1	0	1	0	1
	Decimal Freq (1 MHz) Control	0	1	2	3	4	5	6	7	8	9
7	8 MHz Sel	0	0	0	0	0	0	0	0	1	1
8	4 MHz Sel	0	0	0	0	1	1	1	1	0	0
9	2 MHz Sel	0	0	1	1	0	0	1	1	0	0
10	1 MHz Sel	0	1	0	1	0	1	0	1	0	1
11	Serial Control (High)	Input Control Word 40 Bits Long									
12	Serial Control (Low)	10 Volt Differential, 1 kHz Rate									
13	Shield, Serial Data, Clock	Shields For Lines On Pins 11/12, 14/15									
16	Parellel Preempt	0 TO 1 VDC Parallel Preempt 22-30 VDC Or Open = Not Parallel Preempt									
14	Control Clock (High)	Input 1 kHz Rate. 10V Differential									
15	Control Clock (Low)										
25	LOS Serial Data (H)	Input. R/T Control Word 24 Bits Long.									
26	LOS Serial Data (L)	10 Volt Differential, 1 kHz Rate.									
28	LOS Clock (H)	1 kHz Rate. 10 Volt Differential.									
29	LOS Clock (L)										
27	Shield, Serial Data, Clock	Shields For Lines On Pins 23/24, 26/27.									

ATTACHMENT TO APPENDIX

INTERFACE DETAILS

The Paratune filter is tuned in 1 MHz increments by external digital inputs. Any of four different data interfaces may be enabled: Parallel BCD control, LOS serial control, AFSAT serial control, or LES 8/9 serial control. Logic within the Paratune unit extracts the pertinent frequency data. These data interfaces are employed by the ARC-171 family of equipments and various compatible modems and control units. This appendix briefly describes the interface formats, logic levels, timing, etc.

INTERFACE SELECTION

Selection of the desired interface is controlled by the state of three lines: Parallel Preempt, LOS Preempt, and Serial Clock Rate Control. The following table details the required logic states on these three lines.

TABLE A-4

INTERFACE SELECT LOGIC TABLE

INTERFACE MODE	PARALLEL PREEMPT	LOS PREEMPT	SERIAL CLOCK RATE CONTROL
Parallel	0	Don't Care	Don't Care
LOS	1	1	1
AFSAT	1	0	1
LES 8/9	1	0	0

PARALLEL BCD CONTROL

The Paratune employs the nine most significant lines of the 15 lines parallel frequency control used by the ARC-171. Table A-5 lists the required logic levels.

TABLE A-5

PARALLEL BCD CONTROL

FUNCTION	LOGIC LEVEL									
	200					300				
• 200/300 MHz Sel	0					1				
Decimal Freq (10 MHz) Control	0	1	2	3	4	5	6	7	8	9
• 80 MHz Sel	0	0	0	0	0	0	0	0	1	1
• 40 MHz Sel	0	0	0	0	1	1	1	1	0	0
• 20 MHz Sel	0	0	1	1	0	0	1	1	0	0
• 10 MHz Sel	0	1	0	1	0	1	0	1	0	1
Decimal Freq (1 MHz Control)	0	1	2	3	4	5	6	7	8	9
• 8 MHz Sel	0	0	0	0	0	0	0	0	1	1
• 4 MHz Sel	0	0	0	0	1	1	1	1	0	0
• 2 MHz Sel	0	0	1	1	0	0	1	1	0	0
• 1 MHz Sel	0	1	0	1	0	1	0	1	0	1
Decimal Freq (100 kHz) Control	0	1	2	3	4	5	6	7	8	9
0.8 MHz Sel	0	0	0	0	0	0	0	0	1	1
0.4 MHz Sel	0	0	0	0	1	1	1	1	0	0
0.2 MHz Sel	0	0	1	1	0	0	1	1	0	0
0.1 MHz Sel	0	1	0	1	0	1	0	1	0	1
Decimal Freq.(10 and 1 kHz) Control	0.000		0.025		0.050		0.075			
25 kHz LSB	0		1		0		1			
25 kHz MSB	0		0		1		1			
• Information used by the Paratune										

LOS SERIAL CONTROL

The LOS control is a serial interface. The serial word is 24 bits long and is transmitted over a pair of complementary lines (LOS DATA HI & LOS DATA LO). The LOS clock is sent over a second pair of complementary lines (LOS CLOCK HI & LOS CLOCK LO). Data is shifted on the rising edge of each clock pulse, and the LOS clock rate is approximately 1 kHz. To provide frame synchronization, the LOS clock consists of a burst of 24 clock cycles followed by a period in which the clock is maintained at logic 0 for 8 cycles. The control word must be sent twice without modification before it is accepted as valid by the receiving interface logic. Control word update in the controlled equipment thus occurs after the second transmission of the serial word approximately in the middle of the clock absent interval. Table A-6 lists the format of the LOS control word.

TABLE A-6

LOS CONTROL WORD BIT ASSIGNMENTS

BIT FUNCTION	BIT NO	LOGIC LEVEL FOR FUNCTION DESIGNATED									
		200	300								
*Freq Cont 200/300	1	0	1								
DECIMAL FREQ (10 MHz)		0	1	2	3	4	5	6	7	8	9
*Freq Cont 10-8	19	0	0	0	0	0	0	0	0	1	1
*Freq Cont 10-4	2	0	0	0	0	1	1	1	1	0	0
*Freq Cont 10-2	3	0	0	1	1	0	0	1	1	0	0
*Freq Cont 10-1	5	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (1 MHz)		0	1	2	3	4	5	6	7	8	9
*Freq Cont 1-8	21	0	0	0	0	0	0	0	0	1	1
*Freq Cont 1-4	23	0	0	0	0	1	1	1	1	0	0
*Freq Cont 1-2	4	0	0	1	1	0	0	1	1	0	0
*Freq Cont 1-1	6	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (100 kHz)		0	1	2	3	4	5	6	7	8	9
Freq Cont 0.1-8	7	0	0	0	0	0	0	0	0	1	1
Freq Cont 0.1-4	9	0	0	0	0	1	1	1	1	0	0
Freq Cont 0.1-2	11	0	0	1	1	0	0	1	1	0	0
Freq Cont 0.1-1	13	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (25 kHz)		0.000	0.025	0.050	0.075						
Freq Cont MSB	15	0	0	1	1						
Freq Cont LSB	17	0	1	0	1						
FUNCTION CONT BITS		OFF	MAIN	BOTH	ADF	SATL					
Function Bit (1)	12		0	1	0						
Function Bit (2)	20		0	0	1						
MODE CONT		TONE	AM	OPER	CONT TEST	RX TEST	TX TEST	ANT TEST			
Mode Bit (1)	14	1	1	1	1	1	1	1			
Mode Bit (2)	16	1	1	1	1	1	1	1			
Mode Bit (3)	18	0	0	0	1	1	0	0			
Mode Bit (4)	22	1	0	0	1	0	1	0			
Bit Enable	24	0	0	0	1	1	1	1			

*Information used by the Paratune

AFSAT SERIAL CONTROL

The AFSAT control is a serial interface similar to the LOS interface. The serial word is 40 bits long and is transmitted over a pair of complementary lines (SAT DATA HI & SAT DATA LO). The AFSAT clock is sent over a second pair of complementary lines (SAT CLOCK HI & SAT CLOCK LO). Data is shifted on the rising edge of each clock pulse and the clock rate is approximately 1 kHz. To provide frame synchronization, the AFSAT clock consists of a burst of 40 clock pulses followed by a period in which the clock is maintained at logic 0 for 8 cycles. The control word must be sent twice without modification before it is accepted as valid by the receiving interface logic. Control word update in the controlled equipment thus occurs after the second transmission of the serial word approximately in the middle of the clock absent interval.

Table A-7 lists the format of the AFSAT control word.

TABLE A-7

AFSAT CONTROL WORD BIT ASSIGNMENT

BIT FUNCTION	BIT NO.	LOGIC LEVEL FOR FUNCTION DESIGNATED									
		200	300								
RX Freq Cont 200/300	1	0	1								
DECIMAL FREQ (10 MHz)		0	1	2	3	4	5	6	7	8	9
RX Freq Cont 10-8	19	0	0	0	0	0	0	0	0	1	1
RX Freq Cont 10-4	2	0	0	0	0	1	1	1	1	0	0
RX Freq Cont 10-2	3	0	0	1	1	0	0	1	1	0	0
RX Freq Cont 10-1	5	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (1 MHz)		0	1	2	3	4	5	6	7	8	9
RX Freq Cont 1-8	21	0	0	0	0	0	0	0	0	1	1
RX Freq Cont 1-4	23	0	0	0	0	1	1	1	1	0	0
RX Freq Cont 1-2	4	0	0	1	1	0	0	1	1	0	0
RX Freq Cont 1-1	6	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (100 kHz)		0	1	2	3	4	5	6	7	8	9
RX Freq Cont 0.1-8	7	0	0	0	0	0	0	0	0	1	1
RX Freq Cont 0.1-4	9	0	0	0	0	1	1	1	1	0	0
RX Freq Cont 0.1-2	11	0	0	1	1	0	0	1	1	0	0
RX Freq Cont 0.1-1	13	0	1	0	1	0	1	0	1	0	1
DECIMAL FREQ (25 kHz)		0.000	0.025	0.050	0.075						
RX Freq Cont MSB	15	0	0	1	1						
RX Freq Cont LSB	17	0	1	0	0						
FUNCTION CONT BITS		OFF	MAIN	BOTH	ADF						
Function Bit (1)	12		0	1	0						
Function Bit (2)	20**		0	0	1						

TABLE A-7

AFSAT CONTROL WORD BIT ASSIGNMENT (CONT'D.)

BIT FUNCTION	BIT NO	LOGIC LEVEL FOR FUNCTION DESIGNATED											
MODE CONT		TONE	AM	FM	FSK	TADIL A	ECCM	OPER	CONT TEST	RX TEST	TX TEST	ANT TEST	PREEMPT TEST
Mode Bit (1)	14	1	1	0	1	1	0	X	1	X	X	1	1
Mode Bit (2)	16	1	1	0	0	0	1	X	0	X	X	1	1
Mode Bit (3)	18	0	0	0	0	0	0	0	1	1	0	0	0
Mode Bit (4)	22	1	0	0	0	0	0	0	1	0	1	0	0
Bit Enable	24	0	0	0	0	0	0	0	1	1	1	1	0
Preamp Test	25	0	0	0	0	0	0	0	0	0	0	0	1
SQUELCH		SQUELCH DISABLE						SQUELCH MODE					
(Main)	10	1						0					
(Guard)	8	1						0					
		200						300					
*TX Freq Cont 200/300	26	0						1					
DECIMAL FREQ (10 MHz)		0	1	2	3	4	5	6	7	8	9		
*TX Freq Cont 10-8	27	0	0	0	0	0	0	0	0	1	1		
*TX Freq Cont 10-4	28	0	0	0	0	1	1	1	1	0	0		
*TX Freq Cont 10-2	29	0	0	1	1	0	0	1	1	0	0		
*TX Freq Cont 10-1	30	0	1	0	1	0	1	0	1	0	1		
DECIMAL FREQ (1 MHz)		0	1	2	3	4	5	6	7	8	9		
*TX Freq Cont 1-8	31	0	0	0	0	0	0	0	0	1	1		
*TX Freq Cont 1-4	32	0	0	0	0	1	1	1	1	0	0		
*TX Freq Cont 1-2	33	0	0	1	1	0	0	1	1	0	0		
*TX Freq Cont 1-1	34	0	1	0	1	0	1	0	1	0	1		
DECIMAL FREQ (100 kHz)		0	1	2	3	4	5	6	7	8	9		
TX Freq Cont 0 1-8	35	0	0	0	0	0	0	0	0	1	1		
TX Freq Cont 0 1-4	36	0	0	0	0	1	1	1	1	0	0		
TX Freq Cont 0 1-2	37	0	0	1	1	0	0	1	1	0	0		
TX Freq Cont 01-1	38	0	1	0	1	0	1	0	1	0	1		
DECIMAL FREQ (25 kHz)		0 000	0 025	0 050	0 075								
TX Freq Cont MSB	39	0	0	1	1								
TX Freq Cont LSB	40	0	1	0	1								

X=Don't Care

*=Information used by the Paratune

**=Bit 20 Set at "0" in TX test and Ant test mode

LES 8/9 SERIAL CONTROL

The LES 8/9 interface is used by the LES 8/9 modem to achieve high speed control of the ARC-171. The serial word is 32 bits long and is sent via the complementary lines SAT DATA HI & SAT DATA LO.

The clock is sent over complementary lines SAT CLOCK HI & SAT CLOCK LO. The clock rate is 6.4 kHz and the clock is sent continuously (no clock absent intervals). Data is shifted on the rising edge of each clock pulse. Frame synchronization is provided by a sequence of 11 consecutive "1"s within the serial data word. Updating of the controlled equipment occurs exactly 15 clock periods after the detection of 11 consecutive "1"s.

Table A-8 lists format of the LES 8/9 control word.

TABLE A-8

LES 8/9 CONTROL WORD BIT ASSIGNMENT

BIT FUNCTION	BIT NO.	LOGIC LEVEL FOR FUNCTION DESIGNATED	
Counter Preset (1)	1	0	
(2)	2	0	
(3)	3	0	Mode Control Bits
(4)	4	0	
(5)	5	0	
(6)	6	0	Always Zero
Counter Sequence (1)	7	1	
(2)	8	1	
(3)	9	1	
(4)	10	1	
(5)	11	1	Always One
(6)	12	1	
(7)	13	1	
(8)	14	1	
(9)	15	1	
(10)	16	1	
(11)	17	1	
		200 300	
*FREQ CONT 200/300	18	0 1	
DECIMAL FREQ (10 MHz)		0 1 2 3 4 5 6 7 8 9	
*Freq Cont 10-8	19	0 0 0 0 0 0 0 0 1 1	
*Freq Cont 10-4	20	0 0 0 0 1 1 1 1 0 0	
*Freq Cont 10-2	21	0 0 1 1 0 0 1 1 0 0	

TABLE A-8

LES 8/9 CONTROL WORD BIT ASSIGNMENT (CONT'D.)

Bit Function	Bit No.	Logic Level For Function Designated
*Freq Cont 10-1	22	0 1 0 1 0 1 0 1 0 1
DECIMAL FREQ (1 MHz)		0 1 2 3 4 5 6 7 8 9
*Freq Cont 1-8	23	0 0 0 0 0 0 0 0 1 1
*Freq Cont 1-4	24	0 0 0 0 1 1 1 1 0 0
*Freq Cont 1-2	25	0 0 1 1 0 0 1 1 0 0
*Freq Cont 1-1	26	0 1 0 1 0 1 0 1 0 1
DECIMAL FREQ (100 kHz)		0 1 2 3 4 5 6 7 8 9
Freq Cont 0.1-8	27	0 0 0 0 0 0 0 0 1 1
Freq Cont 0.1-4	28	0 0 0 0 1 1 1 1 0 0
Freq Cont 0.1-2	29	0 0 1 1 0 0 1 1 0 0
Freq Cont 0.1-1	30	0 1 0 1 0 1 0 1 0 1
DECIMAL FREQ (25 kHz)		0.000 0.025 0.050 0.075
Freq Cont MSB	31	0 0 1 1
Freq Cont LSB	32	0 1 0 1

* Information used by the Paratune

TABLE A-9

LOGIC LEVELS

Function	Logic "0"	Logic "1"
Parallel Freq Sel	1/2 ± 1/2 VDC	10 ± 3 VDC or Open
Serial Clock & Data Lines	10 V Differential "LO" positive with respect to "HI"	10 V Differential "HI" positive with respect to "LO"
Parallel Preempt	1/2 ± 1/2 VDC	26 ± 4 VDC or Open
Loss Preempt	1/2 ± 1/2 VDC	10 to 30 VDC or Open
Serial Clock Rate Control	1/2 ± 1/2 VDC	10 ± 3 VDC or Open

TABLE A-10

1 KW POWER SUPPLY FRONT PANEL CONNECTOR
J1 - 3ϕ, 400 Hz, 115V POWER INPUT

PIN NO.	CONNECTION
A	Phase A (Black)
B	Phase B (Red)
C	Phase C (Green)
D	Neutral (White)

TABLE A-11

1 KW POWER SUPPLY CONNECTOR
J2 - AUXILIARY POWER OUTPUT

J2 PIN NO.	FUNCTION
1	+5V A
2	+5V B
3	+5V C
4	+5V D
5	+5V Rtn (A)
6	+5V Rtn (B)
7	+12V
8	+12V Rtn
9	-12V
10	-12V Rtn
11	+50V
12	+50V Meter
13	+50V Meter Rtn
14	+50V Rtn
15	+5V Status
16	+5V Meter
17	+5V Failure
18	Spare
19	+5V Rtn (C)
20	+5V Rtn (D)
21	ϕ A Blowers
22	Spare
23	ϕ B Blowers
24	ϕ C Blowers

TABLE A-12

1 KW P.A. FRONT PANEL CONNECTOR J3 - REMOTE INTERFACE

	FUNCTION	CONNECTED TO
1	Fwd Power (P_{OUT} inc)	Cont J1-47
2	Refl Power	Cont J1-33
3	+50V Meter	J5-12
4	+28V Meter	Cont J1-49
5	+12V Meter	Cont J1-31
6	+5V Meter	J5-16
7	-12V Meter	Cont J1-32
8	Thermal (Meter)	Cont J1-48
9	+28V Low	Cont J1-50
10	+28V High	Cont J1-43
11	Power Sensor Meter	Cont J1-28
12	VSWR Meter	Cont J1-46
13	Pwr High	Cont J1-44
14	P In High	Cont J1-29
15	P In Low	Cont J1-30
16	Filt	Filter J2-18
17	N/C	—
18	N/C	—
19	VCA Out	Cont J1-45
20	Pre Driver Amp	Cont J1-17
21	Driver A	Cont J1-5
22	Driver B	Cont J1-4
23	Driver C	Cont J1-25
24	Output Amp 1A	Cont J1-10
25	Output Amp 2A	Cont J1-12
26	Output Amp 3A	Cont J1-8
27	Output Amp 4A	Cont J1-7
28	Output Amp 1B	Cont J1-11

TABLE A-12

1 KW P.A. FRONT PANEL CONNECTOR J3 - REMOTE INTERFACE (CONT'D)

	FUNCTION	CONNECTED TO
29	Output Amp 2B	Cont J1-14
30	Output Amp 3B	Cont J1-13
31	Output Amp 4B	Cont J1-9
32	Output Amp 1C	Cont J1-21
33	Output Amp 2C	Cont J1-20
34	Output Amp 3C	Cont J1-19
35	Output Amp 4C	Cont J1-18
36	Xmit Only (Mode SW)	Cont J1-6
37	By-Pass (Mode SW)	Cont J1-1
38	Pwr Level (Full/Half)	Cont J1-27
39	Reset	Cont J1-16
40	Carrier Ind	Cont J1-15
41	Drive Ind	Cont J1-2
42	Fault Ind	Cont J1-23
43	+28 Volts	E1
44	Gnd Meter Return	J5-13
45	+28V Rtn	E2
46	Spare	—
47	Spare	—
48	Spare	—
49	Spare	—
50	Spare	—
51	Spare	—
52	Spare	—
53	Spare	—
54	Spare	—
55	Spare	—

TABLE A-13

EXTERNAL INTERFACE TO AN/ARC-171

1 KW CONTROL
CONN. J4

	FUNCTION	CONNECT TO AN/ARC-171
1	Key	J6 - 43
2	Inhibit Arc	J6 - 38
3	AM/FM	
4	200/300 MHz Sel	
5	Ground	
6		
7	8 MHz Sel	
8	4 MHz Sel	
9	2 MHz Sel	
10	1 MHz Sel	
11	Ser. Cont. H.	
12	Ser. Cont. L.	
13	Shield For 11-12, 14-15	
14	Cont. Clock H.	
15	Cont. Clock L.	
16	Parallel Pre-Empt	
17	80 MHz Sel	
18	40 MHz Sel	
19	20 MHz Sel	
20	10 MHz Sel	
21		
22		
23		
24		
25	Los Serial Data H.	J5 - 4
26	Los Serial Data L.	J5 - 5
27	Shield For 25-26, 28-29	J5 - 11
28	Los Clock H.	J5 - 10
29	Los Clock L.	J5 - 18
30	Norm/Hi Speed	
31	Los Pre-Empt	

TABLE A-14

1 KW P.A. FRONT PANEL CONNECTOR
J4 - CONTROL INTERFACE TO
AN/ARC-171

	FUNCTION	CONNECTED TO
1	Key (Driver Enable)	Cont J1-3
2	Driver Inhibit	Cont J1-24
3	AM/FM	Cont J1-26
4	200/300 MHz Select	Filter J2-32
5	Ground	TB1-11
6	—	—
7	8 MHz Select	Filter J2-7
8	4 MHz Select	Filter J2-8
9	2 MHz Select	Filter J2-9
10	1 MHz Select	Filter J2-10
11	Serial Cont H WHT TPS	Filter J2-11
12	Serial Cont L BLK TPS	Filter J2-12
13	Shield For 11-12, 14-15	Filter J2-13
14	Cont Clock H WHT TPS	Filter J2-14
15	Cont Clock L BLK TPS	Filter J2-15
16	Parallel Pre-Empt 0=PP, 22V=$\overline{PP}$	Filter J2-16
17	80 MHz Select	Filter J2-33
18	40 MHz Select	Filter J2-34
19	20 MHz Select	Filter J2-35
20	10 MHz Select	Filter J2-36
21	—	—
22	—	—
23	—	—
24	—	—
25	Los Serial Data H WHT TPS	Filter J2-25
26	Los Serial Data L BLK TPS	Filter J2-26
27	Shield 25-26, 28-29	Filter J2-27
28	Los Clock H WHT TPS	Filter J2-28
29	Los Clock L BLK TPS	Filter J2-29
30	Norm/Hi Speed N=10V, H=0 VDC	Filter J2-20
31	Los Pre-Empt Gnd=Los Pre, Open=$\overline{\text{Los Pre}}$	Filter J2-31

TABLE A-15

1 KW P.A. FRONT PANEL CONNECTOR
J5 - POWER INTERFACE

	FUNCTION	CONNECTED TO
1	+5V A	400W A J3-18
2	+5V B	400W B J3-18
3	+5V C	400W C J3-18
4	+5V D	TB1-1
5	+5V Rtn (A)	400W A J3-36
6	+5V Rtn (B)	400W B J3-36
7	+12V	TB1-2
8	+12V Rtn	TB1-8
9	-12V	TB1-3
10	-12V Rtn	TB1-9
11	+50V	TB1-4
12	+50V Meter	RCU J3-3
13	+50V Meter Rtn	RCU J3-44
14	+5V Rtn	TB1-11
15	+5V Status	Cont J1-38
16	+5V Meter	RCU J3-6
17	+5V Failure	Cont J1-22
18	Spare	—
19	+5V Rtn (C)	400W C J3-36
20	+5V Rtn (D)	TB1-7
21	ØA Blowers	Blower (Yel. Dot-1)
22	Spare	—
23	ØB Blowers	Blower (-2)
24	ØC Blowers	Blower (-3)

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7-8